PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

W. J. JOHNSTON, Prest. C. E. STUMP, Treas. and Bus. M'g'r.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

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New England Office, 8 Cook Building, Boston.
Western Office, 39 Mallers Building, Chicago.
Philadelphia Office, 31 City Trust Building.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $5 a year.

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Matter for the **Editorial** Department should be addressed to

The Editors of The Electrical World New York

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VOL. XIV. NEW YORK, SEPT. 28, 1889. No. 13.

Alternate Currents In Conductors. ON another page will be found an abstract of Mr. W. H. Preece's interesting paper read before the British Association on some experiments carried out by him to verify Sir Wm. Thomson's "Law of Diffusion," which states that an alternating current enters only a short distance into the heart of a thick round copper conductor. The result of these experiments was to prove beyond doubt that the best form for an alternating current conductor is tubular; and they also brought out the curious fact that the fusing current in iron wires varies largely, it taking considerably less current when alternating than when continuous to melt the same-sized wire.

Long Distance Lighting. To judge from the manner in which long distance incandescent lighting is being pushed, it will not be a great while before incandescent circuits will be further reaching than arc—a development that was hardly looked for. We publish in this issue two very interesting articles descriptive and illustrative of long distance incandescent work. The plants in question have both special points of interest. In one case, the current is generated by water power many miles from the centre of utilization. In the other case, the fuel used under the boilers is sawdust and shavings. Thus in both instances there is a use of that which otherwise would go to waste, and the customers of the plants are afforded the best illumination that the world knows to-day.

The St. Louis Exposition. THE notes from our Western correspondent on the St. Louis Exposition show that a creditable display has been given of "electrics" in that city. The situation of St. Louis is such as to make it an old distributing point for a large section of country, and we have no doubt that good results will accrue to the exhibitors who have carried their wares to the exposition in the hope of working up new trade.

A Hispano-Cuban Cable. ANOTHER new cable project, to be added to the many of which we have recently made note, is that to connect Spain directly with Cuba. A cable already runs from Spain to the Canary Islands, and as Cuba is connected with Porto Rico, all that is necessary is to supply the link between Porto Rico and the Canaries. This would be a good piece of work, but does not involve any special difficulties. Such a cable could hardly be made to pay in the commercial sense, but Spain has strategic need for it, and should have laid the cable long ago, as a safeguard for her valuable dependency and an aid to her fleet. Navies and cables are a protection for each other, and a navy gains in strength immensely by the support of a good cable system; but Spain has been slow to realize this rather obvious fact, and hence has risked the loss of her possessions more than once of late years.

Shall It Be "Motorneer?" IN an illustrated article that appears in our columns this week on the electric road at Cincinnati, it is mentioned that the drivers of the cars wear caps, around the band of which is printed in gold letters the word "Motorneer." The word has already slipped into quite general use among electric railway people, but we believe this is the first time that it has been forced upon the notice of the public in a conspicuous manner. A year or two ago, it will be remembered, a sharp little discussion waged in our columns over the propriety of adopting the word, and, though it was then deemed too bad for approval, it was only scotched, not killed; and now it is in greater vogue than ever. The newcomer is like "electrolier," which has become so familiar that its use no longer attracts attention; on the contrary, an attempt to avoid it seems pedantic.

Improvements in Electric Motors. THE strides that have been made in the improvement and perfection of the electric motor are simply astounding, but there is much still to be done. In this issue we give an account of the recent work of Mr. Wm. Baxter, Jr., who for some time has made the electric motor his special study. It will be noted that in describing his new motor, Mr. Baxter lays particular stress on its adaptability to elevator work. This is a most important department, and if Mr. Baxter's claims are sustained, he has certainly made a most praiseworthy advance. Our readers will note also that he has made a direct application of his motor to the wheels of street cars, thus doing away with gearing and its attendant losses. Mr. Baxter is of opinion that he can thus reduce the weight of the electrical apparatus by 60 per cent. This would be a tremendous saving, and we can only hope that it may be so.

The Street Circuits of New York. A FEW accidents have been reported lately as resulting from contact with the arc light wires running overhead through the streets of this city. As usual, the stories have been most wildly exaggerated. Still, there is a substratum of truth, and it may not, therefore, be amiss to make passing note of the situation. The fact probably is that the recent severe and long-continued wet weather has tested the wires pretty thoroughly and found out their weak places. The wonder to us is that some of the circuits show up as well as they do and are not more troublesome. Their insulation in wet weather was low to begin with, and now that they have been up so long their liability to leakage and short circuit daily becomes more pronounced and evident. In view of the fact that there are now on the market excellent brands of overhead insulated wire of high insulation and great durability, such as were unobtainable in the early days of the industry, it would be prudent for the local companies to renovate their circuits wherever necessary. To do so would "pay."

The Pleasure of Electric Travel. IT has latterly been the endeavor of *Harper's Weekly* to give the general public some clear ideas on the subject of electrical applications, and it must be said that the effort has been attended with marked success. One of that paper's latest attempts in this line is a large supplement by Mr. H. L. Nelson on the electric motor as applied to street cars, and the writer of the article is altogether pleased and satisfied with the results of his investigations. After giving a sketch of the development of the art, and detailing the facts in connection with a number of roads, Mr. Nelson winds up as follows: "There is no railroad riding which begins to be so pleasant as that on the electric cars. The service is certain and not dangerous. The advocates of the overhead system have convinced both Houses of Congress, the Legislature of Massachusetts, and the Aldermen of Boston, of the truth of this last proposition, while electric roads have been operated under difficulties occasioned by winter storms that have prevented the movement of horse cars." Here are facts that cannot be gainsaid.

Mascart and his Work As a supplement to his valuable report of the work of the Paris International Congress of Electricians, in which all American electricians have been interested, Mr. Wetzler has forwarded us a biographical sketch and portrait of M. Mascart, the president of the conference. M. Mascart was already well known to Americans as an investigator and writer of unusual skill and ability, but this is the first time that any details of his distinguished career have been published in this country. When bringing to a close the proceedings of the conference, M. Mascart made a very friendly and felicitous reference to the proposal to resume the work of the conference in America in 1892, and we can assure him, and all his European colleagues, of a most cordial and hearty welcome at that time.

Concerning Electric Shock. IN the present issue we publish two interesting communications concerning electric shock. The subject of the intensity of shocks has received considerable attention, but still seems to contain much mystery concerning the current and electromotive force, probably because the victim has not time to study these details. Mr. Gaillard objects to speaking of a shock as so many volts, and holds that it should be spoken of in terms of "current;" but we fail to see how either can be closely measured. The resistance of contact is of immense importance, as a large E. M. F. may be lost in it, and it is something very variable. There is also another thing our correspondent neglects, namely, the effect of the back current on breaking a circuit, which is dependent on self-induction, and which would be large in a circuit of 100,000 volts filled with resistance coils. Surely it is better to speak of "volts," as they are, so to speak, the prime mover, and we do know something about them, for, as Mr. Fessenden says, the taking hold of the brushes of a dynamo generating 2,200 volts—contact being perfect—would subject the recipient to that pressure; but to find the current his exact resistance at that moment would need to be known.

Series Electric Railways. THE "Series" Electric Railway system appears to be meeting with considerable attention in England. In Mr. Manville's British Association paper, an abstract of which we publish this week, a very complete description of the system, as equipped and put in operation on the Northfleet tramway, is given. The principal advantages as claimed for it are, that high tension conductors can be employed, thus minimizing loss of power; that the motors are only subject to a small portion of the tension, and that no damage can be done the motor either by too rapid starting or by reversing while running; also, that when descending a grade it is a clear gain to check the speed of the car by altering the connections, so that the motor tends to revolve in the opposite direction to that in which the car is traveling, and the power is then added to that of the generator. Of course it might be urged that one objection would be that the number of cars on a circuit must be limited by the increase of the tension up to the point deemed safe and convenient; but here again it is possible to imagine that the difficulty could be met on large roads by breaking up the road into sections and feeding direct to each section. On small roads the difficulty would be negligible or would disappear. Now that the series system in this country is to be exploited by well-known electrical engineers, strongly backed, we shall be able to compare notes with our English brethren.

The Patten Alternating Motor. THE opening paper of the season before the American Institute of Electrical Engineers, which we publish in full on another page, with the discussion, was read by Lieut. F. Jarvis Patten. The subject dealt with was a new type of alternating current motor. Lieutenant Patten's motor is of a highly novel and interesting character, at the same time being remarkably simple, and a decided step in the solution of that problem which every day becomes more important—the transmission of power by means of alternating currents. The motor is self-starting, and is at first similar to an ordinary continuous current motor on an alternating circuit. When synchronism is attained, although a true alternating current flows, it traverses the two parallel circuits of the armature always in the same direction, maintaining constant polarity. This result is obtained by a remarkably simple method of armature connection. This redirected current is also caused to traverse the field circuit. The chief disadvantages brought forward in the discussion were that the field magnetism from such a current is wavy, and may attain actual zero; and the sparking effect of a current starting in a shunt wound motor whose field is unexcited. The suggestion has been made to allow the rotating armature to generate a separate, true continuous current to feed the field circuit, which would obviate the above objections. The whole subject was treated by Lieutenant Patten in a remarkably able and clear manner, and we congratulate him upon his success and advancement so far. He has worked in a direction that will lead to definite results in the very near future. The discussion called out by the paper was also very pithy and interesting.

A Biographical Sketch of E. E. N. Mascart.

One of the most prominent and honored names in the world of electrical science is that of M. E. E. N. Mascart, the president of the late International Congress of Electricians held at Paris.

Eleuthin Elu Nicolas Mascart was born at Guarouble (Nord), France, on Feb. 20, 1837. He studied at the College of Valenciennes, and, after graduating there, became tutor at the Lycées of Lille and Douai at the age of 19. In 1858, in order to complete his studies, he entered the École Normal Superieur, and, after completing the course, remained until 1864 as *preparateur*, or assistant professor.

In 1865 he was called to the chair of physics in the Lycée at Metz, and shortly after to the same chair at Versailles. His merits being constantly more recognized, he was called upon in 1868 to take the adjunct-professorship of physics at the College of France, beside the celebrated Regnault, and on the decease of the latter he succeeded to the full professorship.

During the Franco-Prussian war, M. Mascart undertook the sub-directorship of the cartridge and chassepot factory at Bayonne, and at the end of the war was created Chevalier of the Legion of Honor. In 1878 M. Mascart was appointed Director of the Central Meteorological Bureau of France, a position which he still holds with much credit. In 1884, M. Mascart was elected a member of the French Academy of Sciences.

The scientific writings and publications of M. Mascart are quite numerous, and all of eminent value. His first work was published in 1864, and was a memoir entitled, "Researches on the Ultra-Violet Solar Spectrum and the Determination of the Wave Lengths of the Luminous and Ultra-Violet Rays." Since then he has given to the world a large number of memoirs, especially on light and electricity.

In 1876 M. Mascart published his "Treatise on Static Electricity," in two volumes, and between 1882 and 1886 the well-known work entitled, "Lessons in Electricity and Magnetism." This work, in which M. Joubert collaborated, has been translated into the English and German languages. M. Mascart is now engaged on a "Treatise on Optics," of which the first volume has just appeared, and, like all his preceding works, it has at once taken the place of a standard authority on the subject.

Naturally, a man of M. Mascart's abilities would be much sought after as a representative in scientific circles. Thus we find him President of the French Physical Society, a position which he has held before. He has also been president of the Société Internationale des Electriciens and the French Meteorological Society, and he is at present Vice-President of the Consulting Committee on Arts and Manufactures attached to the French Ministry of Commerce.

At the Paris Electrical Exposition and Congress of 1881, M. Mascart was general reporter of the Congress and of the jury, for which services he was created Officer of the Legion of Honor.

In connection with the present exposition M. Mascart is President of the Technical Committee on Electricity, President of the Jury of Class 62 (electricity), and finally President of the International Congress.

As our engraving shows, M. Mascart's countenance is that of a profound thinker and of a man of considerable executive ability; and while wearing a serious expression, is not lacking in lines that denote amiability and goodness of heart. Not the least charm of M. Mascart's personality is his modesty, the attribute of all truly great men.

E. E. N. Mascart.

The Porosity of Secondary Battery Plates.

BY E. R. KNOWLES.

How spongy or porous must the active material of a secondary battery electrode be?

When Faure first made himself known by the invention of his improvement upon the Planté accumulator, the main feature of his invention was the fact that the active material smeared or pasted by him upon the surface of unperforated lead plates, would, when acted upon by an independent source of electricity, become porous or spongy in a very short space of time, and so enormously increase the storage capacity of the plate. The idea seemed to be that the more open or spongy the active material could be made, the greater the amount of storage capacity the plate would have. This idea obtains even now among persons engaged in the manufacture of such plates, although the pasted plates as now made are much more dense than it ever was thought of making them when Faure first announced his invention. The Faure plate as then made was unperforated, the active material in a plastic state being smeared or spread, without any attempt at condensing it by pressure, upon the surface of the plate; and to keep it there a felt bag or other suitable device was wrapped around the plate. But the active material was so soft and spongy that it would not stay placed, and very soon fell off and settled to the bottom of the envelope, and became useless so far as its value for storage purposes was concerned. It was too spongy, and Faure's invention was in danger of being useless for practical purposes. It was not until the perforated plate was introduced and the active material pasted into the perforations that the secondary battery showed signs of commercial value. More pressure had to be used to force the active material into these perforations than was needed to simply paste or smear it on the surface of the plate, until, at the present time, the paint or paste has come to be a stiff plastic mass, which is forced by hand into the perforations in the plate—none being spread upon the surface—with as much pressure and as tightly as it can be done by hand manipulation. The active material is still quite porous, but is a very dense mass compared with what it was as first applied by Faure.

Coming now to still more modern plates, made by other inventors than Faure, we find plates into whose perforations or grooves the active material (as a dry powder) has been rammed or packed as tightly as possible. These plates, when filled with the *proper kind of active material* in the form of a dry powder, and formed by the action of an independent source of electricity, make plates which give first-class results both as regards capacity and durability; and yet the active material is now quite dense in character, too dense to be of value, we are told by the exploiters of the Faure system of pasting. To the contrary, notwithstanding, such plates have been satisfactorily made, notably by Chas. F. Brush, of Cleveland Ohio. Coming down further still, we have a perforated plate into whose perforations the active material, in the form of a dry powder, has been compressed by heavy pressure, in some cases of many tons, until it has been made coherent and very dense in character. Such plates, when filled with the *proper kind of active material*, and acted upon by an independent source of electricity, form excellent plates, of large storage capacity, and very durable in character. The plates now made by the Julien Electric Company are of this type, and are quite satisfactory in their performance. We have here a regular series of porosities, from the first soft mud of the original Faure plate to the dense chalk-like filling of the compression plates; and the question naturally arises, in view of the statements made by the exploiters of the Faure method of pasting, that satisfactory plates can only be made by this process, how porous must the active material of a secondary battery electrode be to give the best results, both as to quantity of electrical discharge in ampéres at a given instant, and the continuance of such discharge for a period of time?

Two important factors which enter into the make up of every accumulator, are ability to give a definite current discharge in ampères and ability to continue such a discharge for a given period of time. The first factor depends upon the amount of surface exposed, which is itself a factor of the porosity of the active material, whereby more or less of its surface is exposed to the action of the electrolyte in which it is immersed. The second factor depends upon the amount of active material in the plate, and both of these factors should be a maximum in value. There must be for a given size of plate a maximum density of the active material which will fufill these requirements. The denser the active material is, the greater quantity there will be of it in a given size of plate, and the longer it will be able to maintain a given discharge, provided it be porous enough to admit of such discharge. A very porous mass, provided it be continuous in its character, may give a very heavy current discharge for a short period of time, and it may also be said that a very dense mass may be restricted to a very small current discharge, which may last for a long period of time. And the question is, what is this limit of density beyond which it is impracticable to go? The results of all experiments in this direction, both by the writer and others, point with certainty to the conclusion, that the densest plates now made by compression of the active material in the form of a dry powder, are amply porous and spongy enough to give as heavy a current discharge, for a much longer period of time, as a similar plate, pasted by the Faure method, not to say anything about their superior durability and cheapness of construction. The writer has in his possession plates filled with dry powder, compressed by 100 tons pressure, which are so porous that if held in a horizontal position and moistened upon the upper side, the moisture will penetrate the whole mass and fall from the other side in drops. These plates are perfectly coherent, and in active operation, doing first-class work in every respect. So long as the mass of the active material can be penetrated by the electrolyte in which the plate is immersed, the active material is porous enough. The limit of density has not yet been reached, and it is possible that plates whose active material is still more dense than any yet made will give still better results.

A Willing Victim for Gerricide.

BY A. GAILLARD.

It seems to me that in most cases people talk of so many volts shock in a very superficial manner. In considering the subject two cases may happen:

1st. A person will accidentally become part of a circuit of, say, 2,500 volts. Now, does that mean that a pressure of 2,500 volts will be exerted through the body of that person? Evidently not, for we might as well say that every arc lamp in the circuit works with difference of potential of 2,500 volts. In my opinion the shock will not be a 2,500 volt shock, but a

$$\frac{M}{M+R}\ 2{,}500 \text{ volts shock.}$$

M being the resistance of the human body, R the resistance of the remaining part of the circuit.

If the meaning of an electric shock due to a current is not to be understood in that way, then it has no meaning at all as far as danger is concerned, and I willingly offer myself to break the record of shock withstanding, by being submitted to a shock of say 100,000 volts, if the figure is considered high enough. All that is necessary will be to put in the circuit enough resistance, and it will not hurt me so much as the sting of a mosquito.

2d. This case is the most frequent, and is when persons accidentally come in contact with a closed circuit. Then the intensity of the shock will vary from no shock at all to a limiting shock always less than the whole electromotive force of the circuit. The point of no shock will be at that part of the circuit which is separated from the terminals of the generating apparatus by equal resistances. The shock received in any other part of the circuit will vary in intensity, with the distance of the part touched to the neutral part, that is the first I named. Instead of talking of shocks of so many volts, people should talk of a flow of so many ampères, and to express the value of the same, they ought to know the real difference of potential they have been submitted to and divide it by the resistance of their body. They will obtain figures that will not reach thousands, not even, perhaps, units, but whose meaning will be exact. If a man can boast of having received a flow of 10 ampères, let him make an offer to P. T. Barnum; a curiosity of that kind will be fully appreciated by the great showman. As an analogy to represent the intensity of shocks, I would say that a now so-called high voltage shock may be compared to a mere shower of rain, while a strong ampère shock would be a dam-breaking flood.

The Striking of the Eiffel Tower by Lightning.

M. Mascart gives the following details relating to the striking of the Eiffel Tower on the evening of the 19th of August last, an event which has been the subject of several exaggerated accounts:

At 9:40 P. M. the principal lightning conductor at the summit was struck, with a noise like that of two small cannons. Some red drops, due probably to the combustion in the air of volatilized iron, fell from the point, and it was subsequently found that the screw at the tip of the conductor was so scored that it was necessary to file it before the set of points could be replaced. A glow, accompanied by considerable crackling, was noticed several times on the rods attached to the platform. The lighthouse-keeper was attending to his apparatus, two men were working the projectors on the platform, and M. Foussat was leaning against the handrail watching the rod attached to the lighthouse. None of these four persons felt the slightest shock at the moment when the flash struck the conductor. However, on account of the heavy rain and the possibility of danger if a second flash struck the tower, the projectors were extinguished, and the three persons on the platform sought shelter in the laboratory. At this moment a highly electrified cloud descended on the top of the tower. It was this doubtless which gave many people in Paris the idea that the top of the tower after the flashes seemed to be enveloped in an electric glow of such intensity that it completely eclipsed the light of the projectors. The meteorological instruments at the bottom of the conductor experienced no injury whatsoever. This flash was, in short, in conformity with all known facts, and showed moreover that the earth connection was perfect, and the tower absolutely safe.

The Englewood, Ill., Electric Light Station.

The late annexation brought within the city limits of Chicago an incandescent plant operating an alternating system, and distributing the current by means of an overhead pole circuit under nearly the same conditions that are to be met with in small towns, where the lighting districts cover an extensive area and the demand for current is limited both in quantity and in length of time required—conditions widely different from those met with in the heart of the great city only six miles distant.

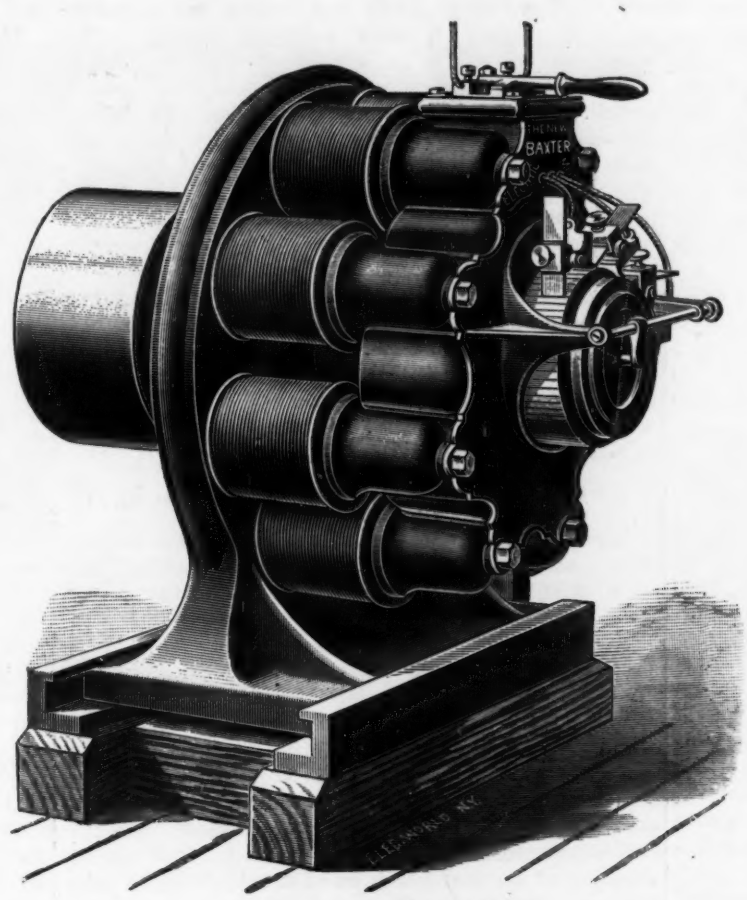
The Englewood Electric Light Company was incorporated in July of last year, the officers, who are equally interested, being John J. Badenoch, president; Joseph Badenoch, Jr., vice-president and manager, and Charles T. Page, secretary and treasurer. The management of the company was turned over to Joseph Badenoch, Jr., who has charge of the power part of the plant, and Mr. Page, who has charge of the electrical department. They examined the merits of the various systems, and finally selected the Westinghouse alternating as being the one best adapted for the various requirements there presented. A single 750-light machine was installed, and the first circuits were constructed; but so quickly were all the lights subscribed for that a second machine of 1,500-light capacity was placed in the station, and as that is now running with nearly its full load, an additional 1,500-light machine will be added—the plant having been in operation less than ten months—which speaks highly of the popularity of the light and the able management of Messrs. Badenoch and Page.

The station is a new brick annex to the large planing mill owned and operated by the firm of Badenoch Bros. No separate steam plant is employed, steam being obtained from the large boilers used by the mill, an extra boiler being held in reserve for use when cleaning or repairing either of the others. The fuel costs practically nothing, being sawdust and shavings, that are shoveled in one motion from the vault into the furnace, the brick vault being placed a few feet in front of the furnace, and the sawdust and shavings deposited therein by a system of fans and blowers that convey it along through galvanized iron pipes from the various machines, thus doing away with all expense for carting or handling of same. The water used is also obtained at a nominal cost from an artesian well sunk within the mill to the depth of 175 feet and affording a stream of unusual purity. This well also supplies a tank holding 10,000 gallons, placed on the top of the mill and affording a system of water works for all the buildings as well as for an automatic water-sprinkling device that is piped through all the buildings for fire protection. Attachments can also be made to the city water supply, should occasion demand it.

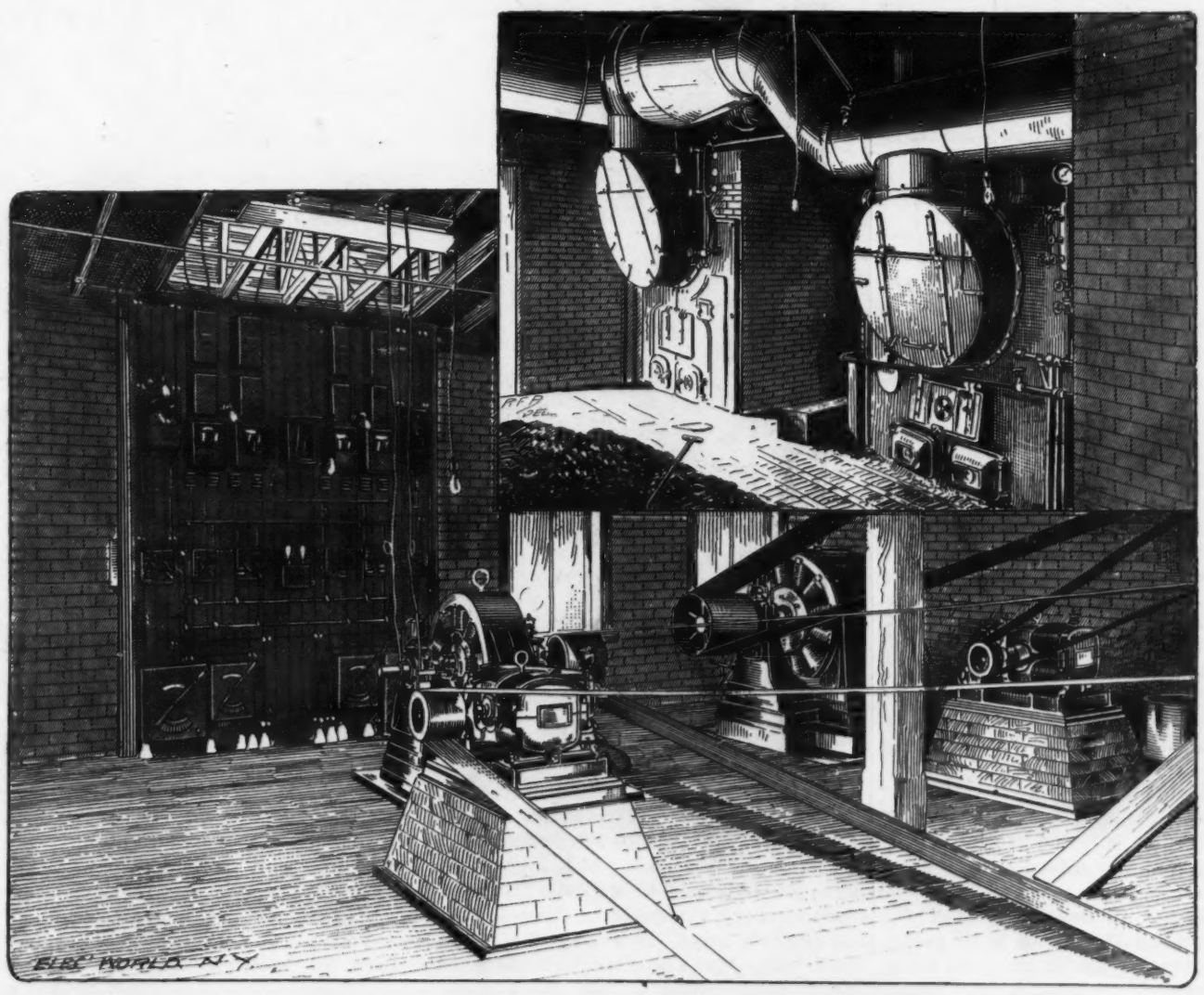
The engine carrying the heavy load of the mill is a 400 h.p. Wheelock, of the latest improved type, that operates the shafting to which is belted the 1,500-light dynamo and exciter now used, and which will carry the third machine as soon as it is placed in position. The remaining dynamo is operated by a 75 h. p. Westinghouse engine belted direct, which carries the irregular and diminishing load. The various steam pipes are surrounded with heavy layers of the Shields & Brown sectional air covering, and an exhaust feed-water heater supplies water to the boilers at a temperature of 200 degrees Fahrenheit. Eight Munson leather belts are used, the main driver being 34 inches in width.

The switchboard shown contains all the latest improvements supplied for the alternating system, including double jaw switches, permitting of the transfer of the load in one movement of the switch handle, fire-proof resistance boxes, etc. The various line circuits have been constructed with great care and with a view to rendering the overhead service as popular as possible. The primary wires are all of the Standard Underground Company's special insulation, except on three circuits, where "Trinidad" was strung, and all the lines are kept taut and snug. Over 15 miles of wire are used on the outside circuits. No motors have yet been placed on the circuit, as there is little demand for them in such a locality, and there being no call for day service in lighting, it would not pay to operate the plant for supplying the current to a few horse-power, only, in motors. The lights are supplied to the usual class of customers found in all towns—churches, halls, stores, residences, etc. Many residences have been wired throughout and use a large number of lamps. The meter system of measurement is employed, works satisfactorily, and customers have no complaints to make. Owing to the residences being scattered over a large territory, the further lights, thus far placed, are two and a quarter miles apart, while additional circuits now being constructed will ultimately carry current to lamps placed at twice that distance.

Too much praise cannot be accorded to Mr. Page for the courtesy which he has at all times extended to his brother superintendents in the service, and for so freely imparting whatever knowledge might be of service in the management of other plants. Mr. Page has been ably seconded in his work by Mr. R. Ferguson, who acts as electrician for the company.



A NEW BAXTER MOTOR.



THE ENGLEWOOD, ILL., ELECTRIC LIGHT PLANT, USING SHAVINGS FOR FUEL.

A New Baxter Motor.

We illustrate on this page a new motor that has recently been designed by Mr. W. Baxter, of Baltimore, in which that inventor adopts a novel form and dispenses with exterior regulating devices.

In the new motor, as will be noticed, there are three brushes on the commutator, all of which are located on the upper side. The regulation is affected by moving the last brush automatically by the governor. The movement of this brush maintains the speed constant by varying the counter electromotive force of the armature. The regulation is very close, owing to the fact that a movement of the brush of less than one-fourth of an inch will vary the counter E. M. F., or what is the same thing, the mechanical output, from zero up the full capacity of the motor.

The governor is of a decidedly novel construction, by which it is possible to obtain a very great centrifugal force or governing power in a very small and compact form, and with a degree of mechanical simplicity not heretofore obtained in such devices. There is no fixed connection between the governor and the regulating brush, nevertheless the latter is moved automatically by the governor, its centrifugal force being resisted by the tension of two springs provided with means of adjustment, whereby the normal speed of the motor may be controlled at will. These springs, as well as the arrangement by which the governor controls the movement of the regulating brush, are not shown, as they are located partly inside the commutator and partly back of it.

The regulating brush is carried on a very light frame, which swings in almost frictionless trunnions. It therefore requires a very small effort to move it, and, as the governor is of such a design as to be very compact, it can be made small enough to be located inside the commutator, where it is not only entirely out of the way, but is thoroughly protected from accidental injury.

One of the advantages of this motor, in addition to those already enumerated, is that it will reverse the direction of its torque if the speed is increased very slightly above the normal velocity, and with a still further increase, the negative torque will rise very fast. The effect of this on the regulator is to prevent racing, If the belt runs off and the armature begins to accelerate its motion, the governor at once moves the regulating brush up to and, if necessary, back of the zero point. By this movement the torque becomes zero and, if necessary, negative, and tends to bring the motor to a stand still.

The governor is so proportioned that a variation of about two per cent. in the velocity from the normal speed will cause it to move the regulating brush from the point of maximum to the point of minimum output, and a further increase in speed of two per cent. will move it beyond the zero line a distance equal to that at which it stands in front when doing the maximum work. Therefore, an increase in speed of four per cent. will cause the armature to resist rotation with a force as great as its maximum torque. Under such conditions it is evident that racing is not possible, as the action is equivalent to applying a brake to the pulley with the full power of the motor,

One of the fundamental principles of close regulation

with centrifugal governors is that all the moving parts, except the governor weights or balls, shall be as light as possible, so that their inertia may be reduced to a minimum, and thus avoid the use of an unnecessarily large governor, and consequently large expenditure of power for the purpose of effecting the regulation. This principle is thoroughly carried out in the motor. The moving parts of the governing mechanism are not only as light as it is possible to make them, consistent with the requisite strength, but the distance through which they have to move is exceedingly small; thus in a 10 horse-power motor the total movement of the regulating brush to vary the load from zero to the full capacity of the machine is less than one-fourth of an inch.

The property of this motor, whereby it reverses its torque when the speed rises above the normal very slightly, is of very great importance in motors used to run spur-gear elevator machines. Motors regulated by cutting out the field cannot be used for this purpose unless specially

"Magnetic Vane" Ammeter.

wound. Mr. Baxter patented a method of winding to adapt his old motor to this class of work, but the regular wound or standard machine, although wound partly in this way, will not give a negative torque of sufficient force to hold back a spur-gear elevator when the car descends with a heavy load, as the reverse torque is only enough to insure close regulation and prevent racing.

To understand the necessity of making a motor that will hold back with a force nearly as great as its maximum capacity, in order that it may operate a spur-gear elevator successfully, it must be borne in mind that when the elevator descends with a full load it requires about two-thirds as much effort to hold it back as it does to raise the same load, and, therefore, unless the descent is resisted by a force nearly equal to this, the velocity of the car would become very great, while the armature would attain such a high velocity as to throw itself to pieces.

The advantages of having a motor of such a character that it will operate perfectly under all the various conditions to which it may be subjected without having to be specially constructed to be adapted to particular cases, is certainly very great and so self-evident as to require no further elucidation.

Mr. Baxter has for a long time believed that by arranging the magnetic field in a certain way, and using a particular method of commutation, the output of a machine could be very greatly increased. As a consequence of this belief he has been working hard for some time past making investigations in the principles of these machines in a new and almost unexplored field. These investigations have resulted in convincing him of the correctness of his conclusions, that by designing electrical machinery in accordance with certain principles, a very great reduction can be made in the weight of the machine as well as in the velocity.

The reduction in weight in most cases is principally a benefit to the manufacturer, but a reduction in the speed is a decided benefit to the machine. It not only reduces the amount of counter-shafting required to transmit the motion but reduces the liability to get out of order and prolongs the life of the motor.

It is well known by those who have had experience in the management of electric machinery, that most of the "diseases of the dynamo" are due to high speed. It is high speed that causes the journals to heat and cut. It is high speed that makes the brushes dance and flash on the commutator, and this flashing, besides burning up and cutting the brushes and commutator, often short-circuits the sections, and in this way destroys the armature coils.

In the new Baxter motor the speed is very low. The 10 h. p. motor runs at a velocity of only 600 revolutions per minute. Notwithstanding this great reduction in speed, the weight is only 800 pounds.

If the new motor were run at the ordinary speed of 1,800 revolutions per minute it would give 30 horse power, which would be an output at the rate of one horse power for about every 27 pounds of machine. At the actual running speed the output is one horse power for every 80 pounds of weight in the machine.

Mr. Baxter has applied the same principles of construction to electric generators, and in the large sizes gets an output of one horse-power for every 25 pounds of machine, and at the very low velocity of 500 revolutions per minute. By a slight modification of the same principles he has succeeded in designing a motor for street car propulsion which, he informs us, gives such an enormous torque that it can be applied directly to the car-wheel axle.

This motor not only does away with all the gearing and its connections now used, but reduces the weight of the electrical part of the car about 60 per cent.

The mechanical features of the new motor are excellent. The shaft runs in bearings that are held by one and the same casting, therefore they cannot get out of line by the loosening of a bolt or in any other way. The armature is held by a brass spider attached to the shaft, and is so secured that it cannot possibly shift or get out of balance. There is a shield that covers the armature so as to protect it from accidental injury. This shield also serves as a support for all the brush-holders, the governor connections, and the starting switch. The design is artistic and symmetrical, and while an abundance of room is given to every part, the outside dimensions are small. The 10 h. p. motor is 22 inches wide, 28 inches long, and 25 inches high; its weight, 800 pounds, and, as stated above, it runs at a velocity of 600 revolutions per minute. The total weight of wire on this machine is 83 pounds. The internal resistance of a 10-ampère motor is $3\frac{1}{4}$ ohms, therefore the energy absorbed by the internal resistance is $3\frac{1}{4} \times 10^2 = 325$ watts, which is less than four and a half per cent. of the total energy of the machine. The frictional loss in this machine is very small, owing to the low speed. The commercial efficiency is between 91 and 92 per cent.

"Magnetic Vane" Ammeters and Voltmeters.

Ammeters and voltmeters, which should be at once accurate, permanent in their indications, and cheap, have for a long time been diligently sought for by electricians. On this page we illustrate the new magnetic vane instruments recently brought out and placed upon the market by Messrs. J. W. Queen & Co., of Philadelphia, and which may be said to have fairly solved the problem. While not claiming that they have secured absolute perfection, the makers do claim that these instruments have as many desirable features as any others in the market, while in some very important respects they possess points of superiority.

This instrument, which is shown in the cut, consists primarily of a coil of wire surrounding two strips of very thin and very soft iron; these strips being as long as the coil is deep and of a width equal to the radius of the space inclosed. One of these vanes is fixed, while the other, to which is attached a long, thin copper needle, is pivoted in the axis of the coil. When a current passes through the instrument these vanes are magnetized in the same sense, and repulsion takes place, which is greater or less according to the strength of the current. This repulsive action is counteracted by the tension of a very light coiled spring of non-magnetic metal. By the use of a supplementary piece of soft iron, cut in a peculiar shape and wrapped about the interior circumference of the coil, a nearly proportional scale is secured. The iron which is used, being of the very softest kind, and cut exceedingly thin, has very little residual magnetism; and no appreciable errors due to this cause are apparent. The pointer and movable vane are very delicately pivoted in caps of polished agate, so that there is practically no friction. The instruments are exceedingly well adapted to station or marine plants, as they may be placed equally well in either a horizontal or vertical position or at any intermediate angle; they are also very dead beat, and give their reading directly. Being entirely free from permanent magnets, they are but little affected by proximity to dynamo machines. They are also exceedingly compact, being mounted in nicely finished brass cases four or five inches in diameter and about two inches deep, the dimensions varying slightly with the capacity of the instrument.

These instruments are wound either as ammeters or as voltmeters. The voltmeters made on this plan can be wound to a much higher resistance than is ordinarily met with, a fact of the utmost importance to electricians.

They are manufactured to cover a great variety of ranges, and in different sizes, according to the use to be made of them. The voltmeters ranging from 0.10 volts will be found especially valuable for storage battery work; above two volts they are graduated in divisions of $\frac{1}{10}$ volt each. Several large wall sizes are also made for station use. Fifty ammeters of this type are now in process of construction for the Brush Electric Illuminating Co. of this city.

The Electric Road in Cincinnati, O.

In the accompanying engraving we give a view of one of the Sprague electric cars on the Cincinnati Inclined Plane Street Railway. This railway runs from the centre of Cincinnati to the foot of an incline, where the cars are hoisted on elevators to the top of the bluff which surrounds Cincinnati, and there run by means of electricity through the suburbs to the Zoölogical gardens. This is the first electric line installed in Cincinnati, and shows how successfully the street railway problem in that city has been solved, and how a substitute for cable roads has been gained.

The view given shows the car rounding the corner of Fifth and Walnut streets, the post office being on the right and Fountain Square on the left. The style of poles used throughout is shown by a single iron pole on the corner. These iron poles are only 4 inches at the top, and are very much lighter and neater looking than the ordinary electric railway pole. In the residential district the streets are bordered with trees, so that the poles are completely covered and cannot be seen.

On Fifth street, just to the right of the poles shown in the engraving, there is a stretch of 550 feet where only three span wires are used, although the street is 200 feet wide. This could only be possible with the light silicon bronze trolley wire, by means of which only a small portion of current is required to be carried from the centre of the street, while the greater portion is carried on main conducting wires on the side of the street.

THE SPRAGUE ELECTRIC ROAD, CINCINNATI, O.

The equipment of this road includes 20 cars, all fitted with the Sprague improved electric railway motor, and all the latest improvements adopted by the Sprague Company upon their most recent roads.

It may be called one of the finest electric railways in the country. The equipment is first class throughout. The track is laid entirely of steel rails, and iron poles are used along the entire electric line. The employés of the road are all dressed in uniform, the men in charge of the motor having a band around their hats with the word "motorneer" inscribed, while the conductors are designated in an appropriate manner.

The president of this road is Mr. H. H. Littell, who is widely known in street railway circles as one of the most successful street railway managers in central United States. The general manager of the road is Mr. H. M. Littell, to whom its success is in a great measure due.

Long-Distance Lighting at Ottawa, Ill.

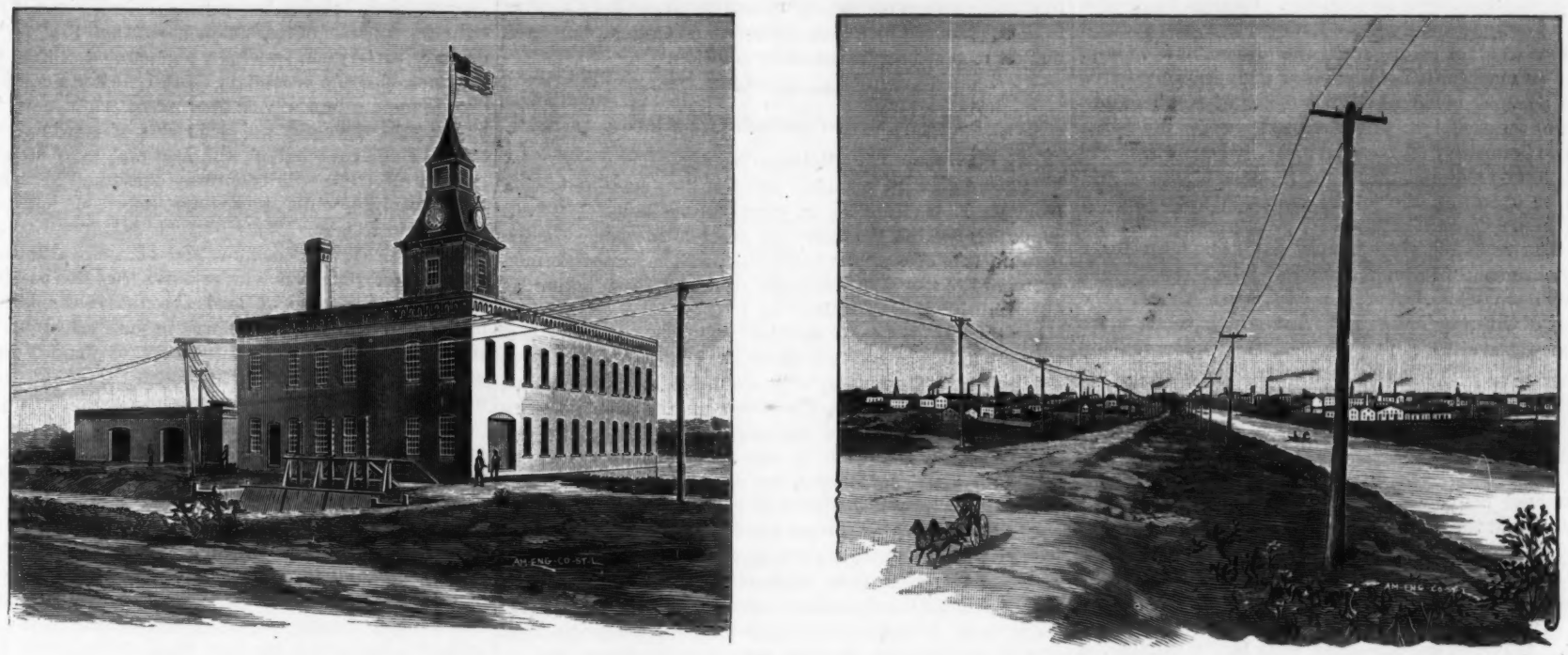
The thriving city of Ottawa, Ill., is situated some seventy miles southwest of Chicago, on the main line of the Chicago, Rock Island & Pacific Railway, and has a population of 12,000. Its citizens are noted for the progressive enterprise shown on all occasions, and they were among the first in the State to secure an electric light plant, and later on installed an electric railway system of some eight miles in length.

This last spring certain gentlemen residing in Ottawa considered the advisability of introducing a system of incandescent lighting suitable for both the public buildings and the suburban residences. An organization was effected on April 17, and the officers of the Illinois Valley Electric Light and Power Company investigated the various systems on the market, with a view to selecting the one best adapted to meet the requirements there presented. The Heisler long-distance system of incandescent lighting was finally chosen.

Through the town run both the Illinois and the Fox rivers, the latter joining the former near the heart of the city and affording ample water power for all the industries there located. After the work of installing the plant had commenced it was discovered that the necessary water power privileges were controlled by parties who were not favorably inclined toward advancing the interests of the new company, and then the alternatives were presented of erecting a steam plant, of dropping the work altogether, or of erecting a station in some adjacent town where water power could be secured. Owing to the competition that was in possession of water power that reduced the operating expenses to a minimum figure, the idea of using an expensive steam plant was abandoned, and the company went eight miles east to the town of Marseilles, where ample water power was secured, and there located the station, two views of which are shown to our readers. Fig. 2 gives a good idea of the long-distance circuits, carried by the side of the Illinois River from Marseilles, and of the pole line along its bank. Fig. 1 affords a view of the building occupied by the company, the power being located in the larger building and the dynamos in the brick structure to the left, where the circuits are seen to start from. Fig. 3 furnishes an inside view of the station, showing the dynamo belted to the shafting, the automatic regulator, etc.

The station house having been located, the work of construction was then pushed, and great care taken to have both pole line and house circuits first class in every respect. For the trunk lines only a No. 8 American gauge copper wire was used, insulated with waterproof covering, although the first lamp reached was placed in Ottawa some eight miles distant from the station. Altogether over forty-five miles of circuits have been strung, including some twelve miles of No. 11 insulated copper wire. The distance along the railway following the river is five miles from Seneca to Marseilles, seven to Ottawa, and ten to Utica.

That the public spirited citizens of Ottawa appreciated the pluck exhibited in carrying the enterprise through to a successful issue is shown by the fact that the first dynamo is now carrying a full load, contracts having been secured for more than one hundred 15 c. p. lamps, one hundred and fifty 20 c. p., three hundred 30 c. p., and about thirty of large sizes ranging to 100 c. p. In addition to this number the company is operating in the town of Marseilles over 100 lamps, and will shortly have 30 more in use for street lighting, and circuits are now being carried into the town of Seneca, some five miles to the east.



FIGS. 1 AND 2.—THE HEISLER ELECTRIC LIGHT STATION AT OTTAWA, ILL., AND ONE OF THE CIRCUITS.

The important features of this installation are (1) the great length of circuits, seldom, if ever, equaled in incandescent lighting; (2) the great area covered; (3) the comparatively slight investment for copper wire, being the least important part of the total cost of the installation, and (4) the fact that the lights furthest from the station are reported to burn as brightly as lamps placed near the dynamos, all of which tends to indicate both the flexibility of the Heisler system and its adaptation for long-distance lighting under circumstances that are often of the most disadvantageous and disheartening character.

The gentlemen who are interested in this installation are George Beatty, president; Nat E. Degen, secretary and treasurer; Lewis Degen, superintendent; L. B. Merryfield, W. H. Stead, C. L. Ballard, F. T. Neff, directors.

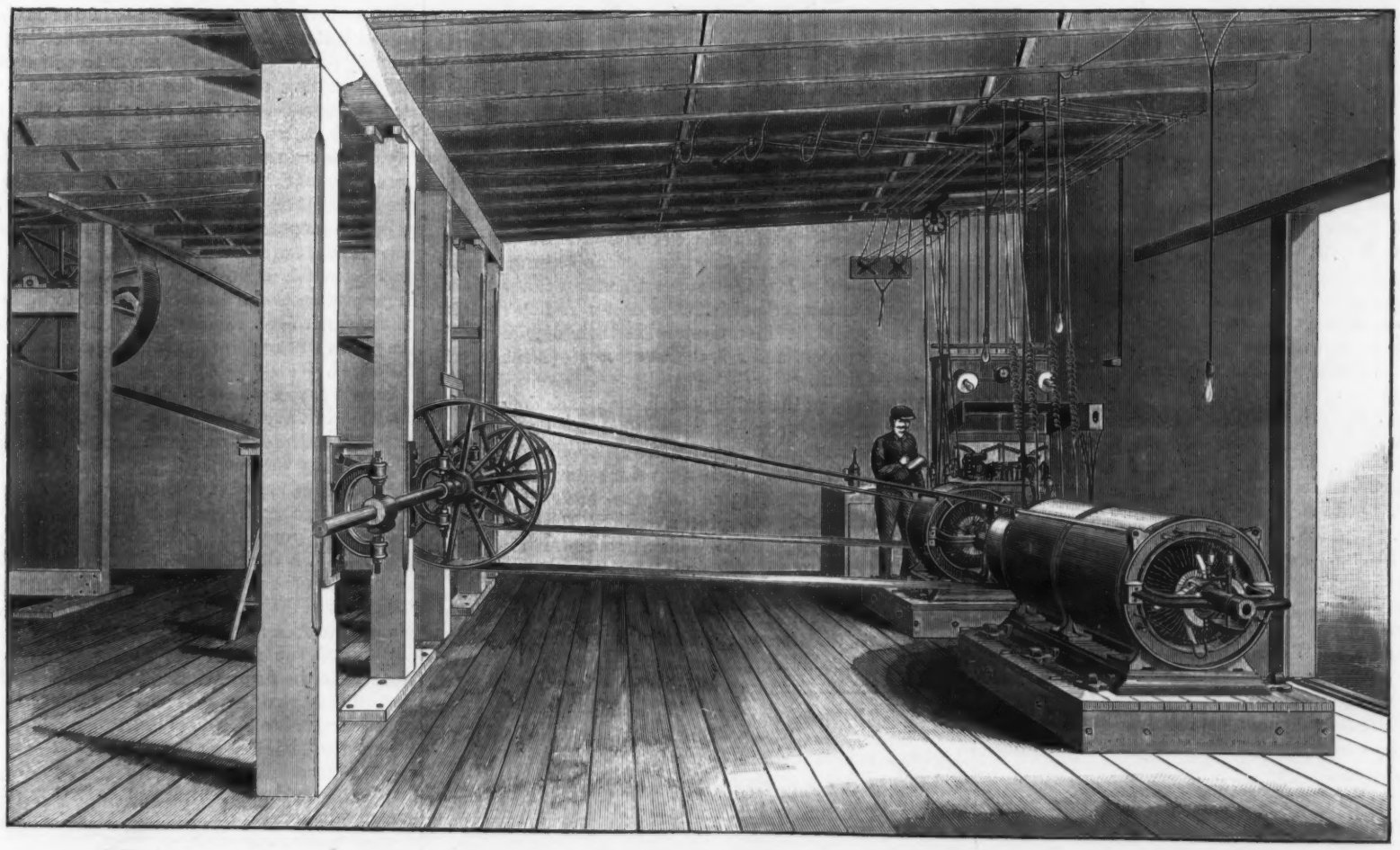


FIG. 3.—INTERIOR OF STATION, HEISLER PLANT, OTTAWA, ILL.

Newton, Mass.—The new station of the Newton Gas Company, built specially for their electric lighting department, is about ready for occupancy, and the apparatus will soon be placed therein. The engines and electrical apparatus now in use at the old station will be used in the new one, and a new engine of 125 h. p. of the compound condensing type manufactured for McIntosh, Seymour & Co., will be added for the purposes of the enlargement.

A New 75 H. P. Electric Motor.

Up to this time nearly all the electrical manufacturers have confined themselves to small motors, and although all have acknowledged that the transmission of power on a large scale is feasible and practicable, yet so far it has been found, commercially, more desirable to keep down the size of motors to something like 25 h. p. or less. The Sprague Electric Railway and Motor Company, of New York, has departed from this routine. Having received a number of orders recently for a larger motor, the demand has had the result of calling forth the present new 75 h. p. motor. This machine is not dissimilar in appearance to the ordinary Sprague standard electric motor of smaller sizes. The first of these motors manufactured was for the Kearney Paper Company, of Kearney, Neb., where about 120 h. p. of electric motors built by the Sprague Company will be used for operating the entire mill. The current for driving these motors is generated by water several miles away. The second of these motors has been built for a long-distance transmission power plant, which the Sprague Company have orders for erecting in South Africa. The efficiency of this machine is remarkably high, while at the same time the speed is kept quite low, the motor making only about 500 revolutions a minute while operating under full load.

The Louisville Meeting of "Old Timers."

The annual convention of the Old Time Telegraphers' Association and the United States Military Telegraph Corps was held at Louisville, Ky., on Sept. 11, at the Louisville Hotel. At 10.30 A. M. President Plum called the U. S. M. T. C. members to order and gave an able address on the subject of the services of the military telegraphers during the war. A report was presented from Mr. Woodring, of Kansas, who secured from the Grand Army of the Republic at Milwaukee an indorsement of the telegraphers' claims upon Congressional recognition. The president appointed Messrs. W. B. Wilson, Philadelphia; H. W. West, Chicago, and D. A. Williams, Kansas City, as a committee to watch and forward their interests in Congress.

Mr. W. R. Plum was re-elected as president, and Mr. J. E. Pettit as secretary. Several applications for membership were received and favorably acted upon.

The Old Timers' Telegraph Association held its meeting at 2.30 P. M. the same day. President Chas. E. Taylor delivered an extremely able and interesting address, and the routine business was quickly disposed of.

Upon conference with the Military Corps, Kansas City was chosen as the next place of meeting for both bodies, and Mr. Day K. Smith, of that place, was elected president. Mr. Barney Hughes, of Memphis, was chosen vice-president, and the ever-popular W. J. Dealy, of New York, was re-elected secretary and treasurer. The next meeting will be held the second week in September, 1890.

The attendance at both meetings was excellent. The delegation from New York numbered no less than 25, and other cities were also well represented.

The formal proceedings were supplemented by excursions, a visit to the Mammoth Cave and a banquet. The following were present at the banquet, many of them being accompanied by ladies: T. J. Batman, J. Brant, M. J. Burke, W. L. Briggert, Gen. D. C. Buell, J. J. Calahan, J. N. Crittenden, J. F. Cleverdon, W. J. Dealy, E. Delaney, James D. Reid, Gen. Basil Duke, G. M. Dugan, Capt. Irwin Dugan, A. L. Eugene, A. L. Eggleston, T. B. Fallon, S. B. Fairchild, T. Finnigan, J. H. Emerick, Col. W. S. Hays, R. J. Hutchinson, Barney Hughes, G. E. Holbrook, E. O. Hewitt, W. L. Ives, U. J. Johnson, Lant Jones, C. H. Kahlert, Judge J. B. Kincaid, J. Knittle, J. F. Ludwig, J. H. Lounsbury, K. McKenzie, D. McDonald, C. Newton, A. J. Porter, W. R. Plum, J. E. Pettit, Sol Palmer, E. Rosewater, R. G. Stephenson, T. P. Scully, C. Smith, C. E. Taylor, R. A. Taylor, W. B. Wilson, D. Wilson, D. A. Williams, R. Weissinger, R. B. Woolsey. The banquet was interspersed with instrumental music and singing and by speeches, the Hon. W. B. Wilson giving a specially stirring address.

Much of the success of the meeting was due to the efforts of Mr. C. Smith, the manager of the Louisville Western Union office and chairman of the Committee of Arrangements.

Curious Effects of Metallization in a Vacuum.

In the *Revue Internationale de l' Electricité*, "G. M." writes: "We have received from M. Gaston Seguy two samples of tubes in which the volatilization of metals in a vacuum by the passing of the electric current has given rise to some curious phenomena, which we are unable to explain satisfactorily.

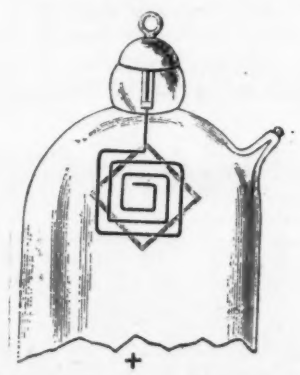
"A glass tube three centimetres in diameter is closed at the two extremities, and to each end is soldered an electrode of platinum or copper of the form shown in the adjoining figure. Through a nipple on the side of the tube a vacuum equal to that of the Geissler tubes is produced by means of a mercury pump; then the current of a powerful induction coil is passed through. The metal is then volatilized at the negative pole and is deposited on the sides of the glass, producing a black discoloration for platinum and yellow for copper. The metallization of the sides of the tube is more rapid in proportion as the diameter is smaller. But in any case it produces this curious phenomenon. It does not take place at all on either side on that part of the tube placed directly opposite the plane of the electrode, as seen by placing the tube before a sheet of white paper. The reservation thus obtained exactly reproduces the external form of the electrode; but what is still more curious is, that the angles of this outline do not correspond to the angles of the electrode, but come opposite the straight lines as shown in the accompanying figure." These are phenomena similar to those observed by Crookes, Jamin and Goltein, but have not yet received any satisfactory solution.

The Nature of Secondary Batteries.

To the Editors of The Electrical World:

I have read with surprised interest the communication from Mr. E. R. Knowles in your current issue. I did not suppose it possible that any one practically engaged in the manufacture of secondary batteries could be so misinformed in regard to the simplest facts relating to their action as Mr. Knowles appears to be.

Quoting Judge Coxe's decision, that "A secondary battery is one which gives no electricity of itself, but is active only when rendered so by a current (of electricity) from an independent source," Mr. Knowles remarks that a "very large portion of scientific investigators" believe that a secondary battery is any one in which chemical energy can be stored up when acted upon by an independent source of electricity, and which will then itself give off a current of electricity;" adding that there are a large number of primary batteries which may not only be partly restored, but completely restored to their original condition by the action upon them of an independent source of electricity. According to these scientific investigators, then, a large number of primary batteries are also secondary batteries, and accepting their definition, this is perfectly true. But Mr. Knowles argues from Judge Coxe's definition (I take it this is the definition he refers to, although it appears from juxtaposition of words that the scientific investigators'



Metallization in a Vacuum.

definition is the one alluded to), that a primary battery, although capable of storing up chemical energy through a charge of electricity from an external source, and of giving this energy out again in the form of an electric current, cannot be a secondary battery. All that I can make out of this conclusion is that Mr. Knowles differs in his opinion from the scientific investigators in their definition of a secondary battery, and it is therefore not evident why he has quoted them.

Thus admitting the validity of Judge Coxe's definition of a secondary battery, Mr. Knowles infers that "a perforated plate or grid having the active material applied to it in the form of a paste, paint or cement, prior to immersion in the electrolyte, and which is practically insoluble in the electrolyte, but which will give a current of itself, without being acted upon by an independent source of electricity, is a primary battery." Without remarking the difficulty of comprehending how a single plate of any character can constitute a primary or any other kind of a battery, I decidedly deny that two or any number of such plates will form a primary battery, assuming the plates to be prepared in the manner he proceeds to describe, viz.: "If the plates or grids be pasted, the one with peroxide of lead and the other with sponge lead, and then immersed in a solution of sulphuric acid and water, the cell will be a primary cell, and will be active at once without any aid from an independent source of electricity."

Now, it must be remembered that some of the words included in one of the above quotations from Mr. Knowles' communication (viz.: "An electrode for a secondary battery to which the active material has been applied in the form of a paint, paste or cement, prior to immersion in the electrolyte, and which is practically insoluble in the electrolyte,") describe the Faure invention owned by the Electrical Accumulator Company, as sustained by Judge Coxe. And the reason why two plates prepared after the manner described by Mr. Knowles will not be "active at once" is specifically because electrodes so prepared are made in accordance with the aforesaid invention, and are not soluble in the solution described. If Mr. Knowles could prove this assertion which he has made, the production of electricity would be revolutionized; for if current could be obtained from such a primary (?) battery, without solution of either of the electrodes, there would obviously be no consumption of their substance, and electricity would be generated without waste of material. Doubtless Mr. Knowles may have observed that electrodes so prepared and used do give off a feeble current for a brief interval. This occurs because there *is* a slight *solution* of the oxygen of the lead oxide, but the current is evanescent, and no careful observer would for a moment imagine such a combination to be a commercially operative primary battery, while theory proves it impossible.

Incidentally I may here remark that one distinguishing characteristic between true secondary batteries and primary batteries capable of partial regeneration (for no known primary battery can be wholly regenerated) is this: whereas the electrodes of a secondary battery after a complete discharge remain precisely as they were when new, without loss or gain of weight, the electrodes of a primary battery after a similar discharge will lose and gain weight; the positive electrode will be entirely consumed by solution in the electrolyte, while the negative electrode will generally increase in weight.

After describing this new and economical form of primary battery, Mr. Knowles remarks that there is difficulty in securing the paste of lead peroxide in the perforations of the plate when it is immersed in the electrolyte. He further says that there are other ways of making first-class accumulator plates than by means of applying the active material in the form of a paint, paste or cement, and proceeds to describe two. The first method is to "fill the plate or grid with the active material in the form of dry powder, compressed by pressure so as to fill the plate with a solid coherent mass." The second method is to "compress the active material in the form of a dry powder into solid masses of given form, and then to either cast or form the metal of the plate proper around such masses." Now, the best answer I can make to the statement that first-class accumulator plates can be made by the first-described method is to mention the fact that, although Mr. Knowles has been free to adopt that method, he has always employed the paste or Faure method, controlled by the Electrical Accumulator Company, in the batteries he has manufactured for commercial purposes, and although he has been legally restrained from using such cells, he has not, so far as I am aware, succeeded in substituting others prepared after the dry powder method. I may add that my own endeavors to make a dry powder battery, which have not been few, have met with only a degree of success, not approaching the perfection attained by the Faure process. The second described method has been adopted by two or three different inventors, but the only batteries made by that process that I have personally examined were those of A. Reckenzaun, and in these the pellets were compressed from a previously prepared paste of the oxide. Indeed, I cannot believe that a dry oxide pellet, no matter how forcibly compressed, can be made to withstand the necessary handling during the manufacture of the plates. Again, there are two fatal objections to this form of electrode: By their very nature the pellets must be more or less enveloped by the supporting plate, and, as less effective surface is thus exposed, the capacity of a plate with a given weight of oxide is greatly reduced. Furthermore, pellets so prepared must have considerable magnitude, and this reduces the amount of surface in contact with the conducting metal, and exposes large surfaces (although small in proportion to the amount of oxide) to the washing action of the electrolyte. Besides this, the slightest buckling of the plates will rupture the pellets and cause them to become dislodged.

In reference to the difficulty which Mr. Knowles has encountered in avoiding the dislodgement of the active material when the electrodes are immersed in the electrolyte, I have to say that while this would be a necessary consequence of the use of dry powder, no difficulty occurs when the active material is prepared in the form of a paste in the manner practiced by the Electrical Accumulator Company. When the cells manufactured by this company are used within the prescribed limits, such a thing as the dislodgment of the pellets is very rare. If the cells are overcharged to such an extent that all the sulphate in the paste is removed, the surface of the paste is apt to dissolve or float off in the form of a finely divided powder. It is also possible to dislodge the pellets if the cells are totally discharged, so as to become heavily sulphated, and are then charged at a high rate; but when used in the manner specified by them the cells manufactured by the Electrical Accumulator Company are not subject to the defect noted by Mr. Knowles.

Geo. B. Prescott, Jr.

New York City, Sept. 19, 1889.

Spark Coils for Gas Lighting.

To the Editors of The Electrical World:

I intend to make a spark coil for electric gas-lighting. Kindly inform me through your valuable paper how this can best be done.

1. Will a length of 10 inches do for the coil?
2. What number wire, and how much of it will be necessary to use for winding?
3. Which is best, an iron rod or a bundle of iron wire?
4. What diameter should the iron core have?

New York City. H. A. Laurent.

Answer.—1. From 8 to 10 inches.
2. About 400 or 500 feet, N. 18 B. S.
3. Iron wire (the finer the better).
4. Three-quarter inch will be sufficient.—Eds. E. W.

Edison and His Inventions at the Paris Exposition.—V.

BY W. J. HAMMER.

(*Copyright*, 1889.)

PHENOMENA IN INCANDESCENT LAMPS.

Fig. 24 illustrates phenomena in incandescent lamps which Mr. Edison has illustrated by some elaborate and highly interesting experiments. He observed that when a strip or wire placed between the poles of a carbon loop was connected to a galvanometer at one end of its terminals, and at the other with the positive wire of the lamp, a strong current was observed, while connecting to the negative pole indicated practically no current. He found that upon raising the electromotive force, the derived circuit current became very strong, although there was a considerable break in the circuit inside a high vacuum; and he operated successfully telegraph sounders, relays and other apparatus, as shown in diagrams 1 and 2.

The accompanying sketch of lamps illustrates his experiments to determine whether the effect was due to induction and conduction, or to a molecular bombardment, such as occurred in the "Crookes effect." It is probable that the "Edison effect" is due to all of these. While the current existed where the third pole in the lamp was in a straight line, in any direction from the carbon within the rarified space, when the platina strip or wire was placed at the end of a crooked tube, or in a position similar to those shown in diagrams 4, 5 and 6, it was absent.

Diagram 3 shows an application of this apparatus to the regulation of currents of high electromotive force, although it is not suitable for low pressures, as the effect is scarcely perceptible with a standard 16 c. p. lamp until about 85 volts is reached. It is doubtfult from the results of Mr. Edison's experiments if it would be reliable, as the current is not only weak but very variable.

The experiments conducted by Mr. Edison and Mr. William H. Preece, of England, have demonstrated the intimate connection between the appearances of the "shunt current" and the "blue effect" noticeable in incandescent lamps at too high an E. M. F., and either may be taken as a danger signal that the E. M. F. is getting too high. It is of interest that it makes no appreciable difference whether a plate or wire be used, or whether the same be of copper, iron, platina or carbon.

THE EDISON-SIMS TORPEDO.

This is the joint invention of Mr. Edison and W. Scott Sims. It consists, as represented by Fig. 25, of a submarine torpedo boat operated by electricity. It contains a motor, controlling, reversing and steering devices, which are operated by a cable from shore or shipboard, as well as carrying the explosive charge and means for discharging same at the proper moment. This instrument of warfare has excited much attention, and orders for it have already been received from several foreign countries, as well as the United States.

SECONDARY BATTERIES.

As early as 1882 Mr. Edison filed two applications for patents upon accumulators or storage batteries. They are shown in diagrams 4 and 6 in Fig. 18. The former employs finely divided or spongy metallic lead, the claims covering the formation of plates from finely divided lead with compressed portions for connection and also insertion of perforated or porous insulating partitions. The latter patent employs lead in an arborescent state, either partly or wholly, and integral throughout its mass. This form is obtained by pouring molten lead from a height into water, or some powdered material, or by blowing air through molten lead.

The primary battery in diagram 2, Fig. 18, was also invented by Mr. Edison. The patent covers an arrangement of the copper plate above the sulphate of copper in preference to the usual method of placing it beneath, as he observed that he has increased the efficiency of the zinc and kept it free from zinc. This practice has now become almost universal.

FRUIT PRESERVING.

In Fig. 26, diagram 1 illustrates Mr. Edison's invention for fruit preserving in high vacuo without cooking. As shown in the figure, it consists of an air pump to commence the exhaustion, a Sprengel mercury pump for high exhaustion, together with the receptacle to be exhausted containing the fruit. He experimented also upon various gases to prevent decomposition.

Diagram 2, Fig. 26, shows a combination vacuum pump, patented and used by Mr. Edison. It is a modification of the Geissler pump and Sprengel pump with the McLeod gauge, spark tube, drying tube, etc. A far simpler device is now employed.

THE ETHEROSCOPE.

In Fig 27 is shown what Edison terms his etheroscope for demonstrating certain phenomena which he for some time believed to prove the existence of a new force which he termed "etheric force," but which later was demonstrated by Professors Thomson and Houston to be due to some remarkable properties of induction.

As shown in diagram 1, it consists of a microscope carrying two fine carbon points, one having no connection, and the other connecting to a circuit breaker or vibrator which is in a closed circuit battery. Whenever the circuit is broken a bright spark appears between the carbon points, although it is not in the battery circuit.

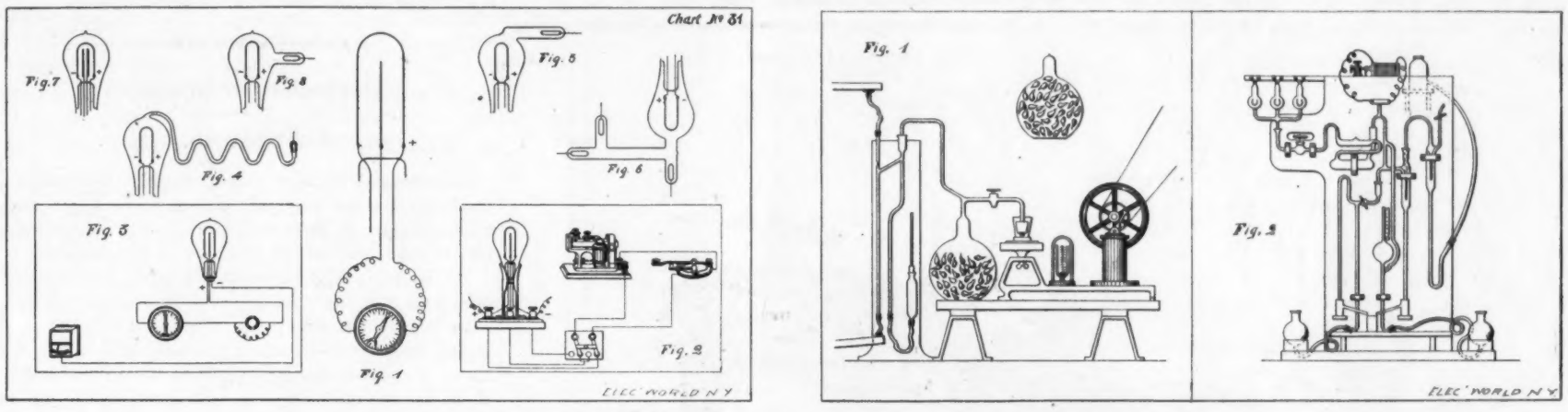
Another arrangement is shown in diagram 2, where a considerable break occurs in the circuit, also between the rod and solenoid, which latter is in the closed circuit with the vibrator and battery.

THE PHONOGRAPH.

This marvelous instrument was invented by Mr. Edison in 1877, although the first suggestion of it was received while a young man when acting in the capacity of a night operator in a telegraph office in Boston, where he constructed a piece of apparatus which enabled him to indent a strip of paper with the dots and dashes of the Morse alphabet, which, when pulled through a transmitting instrument, enabled an electric circuit to be opened and closed by means of the indentations in the paper. Long afterward, during extensive experiments on the telephone, while shouting into a mouthpiece of a telephone to the diaphragm of which a needle was attached, the pin pierced his finger and drew blood. Edison, with that keen perception so characteristic of him, said he believed he could make an instrument upon this principle which would record the sound waves emanating from the throat, and he laid a wager with one of his assistants that the instrument would talk, and, remarkable as it may seem, it did so on the first trial.

When the phonograph was first exhibited before that august body the French Academy of Science, its members looked upon it with suspicion. Bouillard, the eminent physicist, declared the gentleman in charge to be a clever ventriloquist, and demanded that the instrument be shown in a private room to a special committee, and that Count Du Moncel should have charge of the instrument. Then, and only then, did these astute scientists give credence to the wonderful instrument, which they had so loudly declared to be another "Yankee humbug."

The original phonograph, which is shown in Fig. 29, is in the British Patent Office Museum at South Kensington. The perfected instrument of to-day does not differ in principle in any respect from this. In Fig. 30 is shown the perfected form of the old type employing a drum of brass carrying a continuous thread of 37 turns to the inch, over which is wrapped a sheet of tin foil for receiving the indentations of the needle attached to the vibrating diaphragm. The heavy fly wheel at each end of the shaft tends to give uniform speed, it being turned by hand. In Fig. 28 is shown the standard type embodying all of Edison's most recent improvements. These consist in the employment of phonograms or hollow cylinders of a chemical composition in lieu of the tin foil formerly used. In his early patents Edison refers to the employment of wax, which, however, was not found satisfactory. The increasing of the number of threads on the cylinder, 100 to the inch; the use of electricity as a motive power in place of hand power; the automatic governing of the speed; the employment of a spectacle carrying on the right a transmitter or recorder, and on the left a receiver or reproducer; the mica diaphragms replaced by glass of about $\frac{3}{1000}$ of an inch thick; the half dozen adjustments in the old type giving place to one adjusting screw in the new, rendering it very simple to handle, are all great improvements. One of the principal changes is



FIGS. 24 AND 26.—EDISON LAMP EXPERIMENTS, FRUIT PRESERVING, ETC.

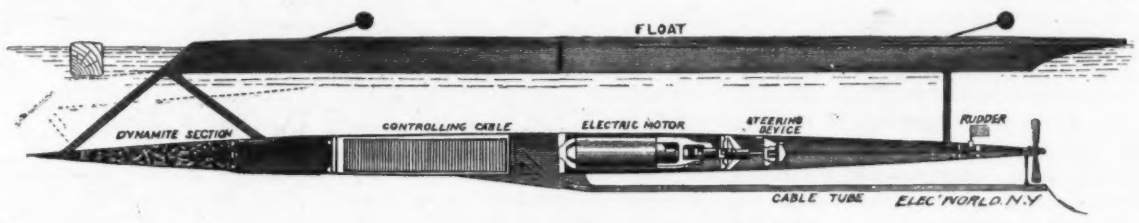
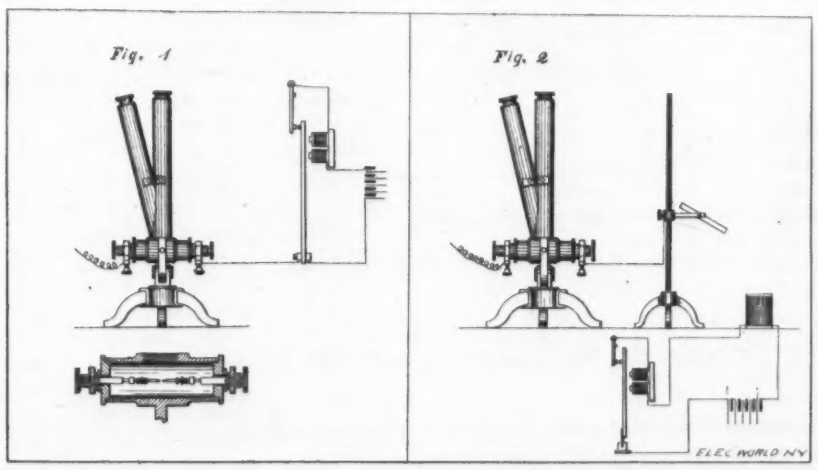
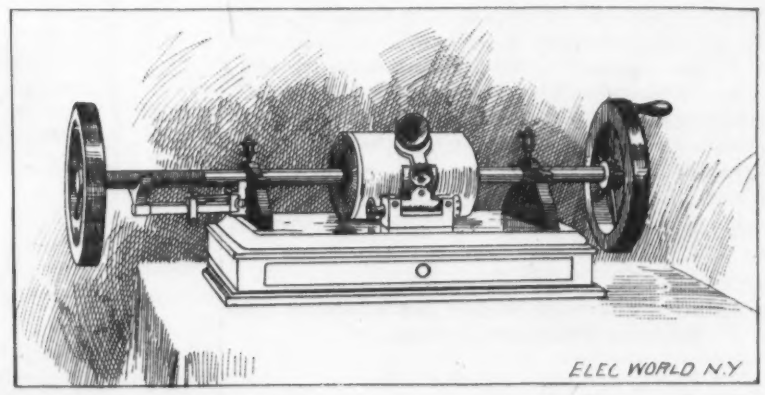


FIG. 25.—THE EDISON-SIMS TORPEDO.





FIGS. 27 AND 30.—EDISON ETHEROSCOPE AND PHONOGRAPH.

the sacrificing of sound to articulation, which has been wonderfully increased. Another great advantage is the ability to turn down the cylinder as often as 150 times, giving a fresh recording surface each time.

The transmitting needle cuts a groove about $\frac{5}{1000}$ of an inch broad, and the receiver or reproducer needle is about $\frac{6}{100}$ of an inch broad, magnified representations of the groove showing indentations as shown in diagrams 1, 2 and 3, Fig. 29, and the recorder and reproducer are also shown in diagrams on the right in Fig. 29.

By way of explanation of the principles underlying this instrument, note that when I strike this bell before me, the blow sets the particles of metal into vibration, which vi-

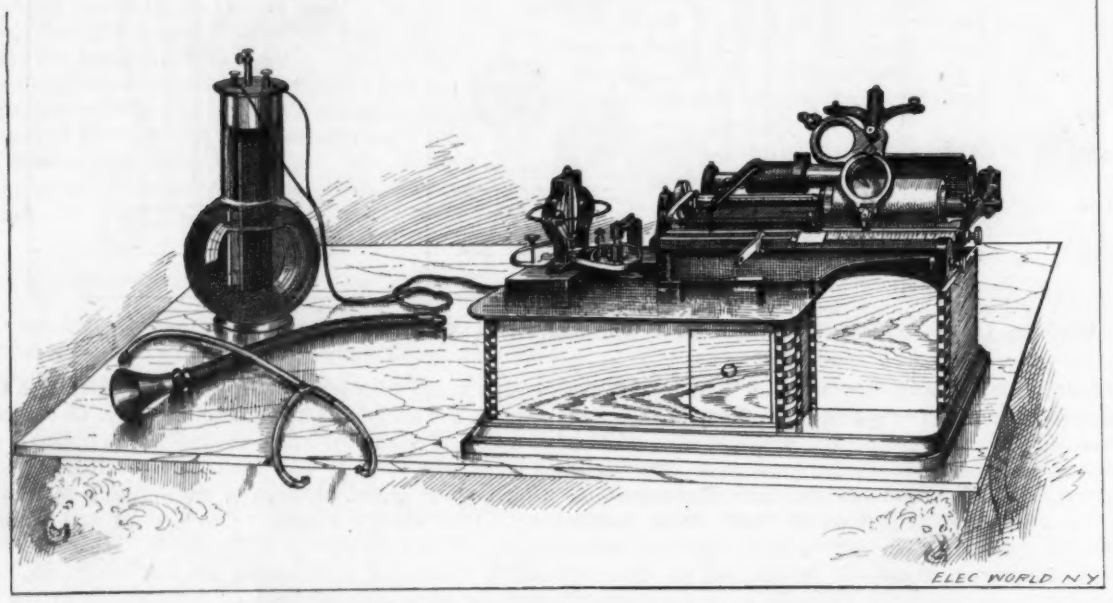


FIG. 28.—THE LATEST TYPE OF PHONOGRAPH.

brations are communicated to the surrounding atmosphere, which, being an elastic medium, conveys the impulses to the ear, and the waves of sound roll in very much as the waves come rolling in toward the shore down by the sea. The speed at which sound travels is 1,093 feet per second at the temperature of freezing water, and as the temperature rises the speed increases about one foot to every degree.

Every one in this room has in his or her throat a delicate membrane, which, when they speak, is set in vibration, and in turn sends the vibratory impulses from the throat and mouth, and they impinge upon the drum of the ear. This membrane vibrates at different rates in different persons. For instance, in the soprano of the ladies it is exceeding rapid, while the bass of the men singers is much slower. From this we find that the pitch of a woman's voice is far higher, as a rule, than that of a man. The pitch of a tone depends upon the number of vibrations in a second, and upon nothing else; therefore, if a tone is produced with double the number of vibrations of another, it is said to be an octave higher. Now, when we speak into the mouthpiece of the phonograph transmitter, the sound waves impinge upon the glass diaphragm, which causes the needle attached thereto to indent the composition cylinder as it traces over the surface. The depth, length and general character of these indentations depend upon the character of the sound waves. When the tone is loud and full, they are deep, and when the pitch of the tone is high the indentations are close together. After talking into the recorder, the spectacle is turned to the right, bringing the reproducing needle into play, which, as it traverses the track made by the broader needle, slips in and out of the indentations therein, and in so doing moves the reproducing diaphragm with it, and thus, by mechanically imitating motions of the diaphragm in one's own throat, reproduces the words spoken.

On the Relative Effects of Steady and Alternate Currents on Different Conductors.*

BY WILLIAM HENRY PREECE, F.R.S.

1. Sir William Thomson, at the Bath meeting of the British Association, startled the electrical world by asserting that alternate currents entered a distance of only about three millimetres into the heart of a thick, round, copper conductor when the frequency was 150. This "Diffusion Law," as he called it, is based on the assumption that a current starts at the surface of the conductor and works its way radially inwards. It is dependent on the coefficient of self-induction and on the frequency, that is, on the number of complete alternations of positive and negative currents transmitted per second.

2. It occurred to me, however, to study the change of temperature in various couductors with direct and alternating currents. Any addition or diminution of energy expended would give some indication of the operation of the law of diffusion.

5. In the preliminary experiments to determine the mode of procedure, conductors of copper, iron, lead and platinoid were used, but in the final experiments only iron and copper were employed. Each metal was taken of the same length and of the following forms: Round rod, flat rod, tube and stranded cable.

6. The observations were taken sometimes with steady currents and sometimes with alternating currents first. Each kind of current, after being switched on, was kept constant until all expansion ceased, after which the current was instantly changed to the reverse kind, and any change of elongation observed. Each experiment lasted from twenty minutes to half an hour.

7. As regards copper, with either a steady or alternating current, the effect of heat generated in the conductors was virtually the same; but the tube gave the best results, owing, doubtless, to the increased radiating surface.

8. The performance of the iron conductor is very decided. Here we have a large increment of heat, due clearly to reversals of circular magnetization. Hysteresis evidently plays a most important function, and the conductor in consequence becomes a source of heat, which varies in intensity, not only with the hysteresis, but also with the frequency of the alternations.

9. The difference of behavior between iron and copper is very marked in the sounds they emit when transmitting alternate currents. Iron vibrates mechanically, and emits loud, powerful sounds, filling the room with a roar, and increasing in intensity with the frequency. The sound of copper is very slight, and only perceptible when the ear is close to the conductor, even with the maximum current. It is only what one would expect from rapid variations in emissivity under such alternations.

This vibration, so marked in iron, has a very important bearing on the durability of the insulating material; for it is difficult to conceive any material that could stand without injury for any length of time such molecular disturbances.

10. This generation of heat in iron conductors leads to the conclusion that the fusing current for small wires would differ considerably between steady and alternate currents. All tables are made on the basis of steady currents. No. 11 iron wire, 116 millimetres (.295 centimetre) in diameter was taken.

Calculating fusing current	122	amperes.
Steady "	120	"
Alternating "	92	"

No difference was observed with copper.

11. The general conclusion to be drawn from these experiments is that practically no error has been made in the form of conductors so much used for alternating-current systems, and that nothing cheaper or better has been devised than a simple stranded conductor, coated with a suitable insulating coating, and protected outside with lead, or some impervious and strong material.

They do not solve the question of the distribution of current density through the section of the conductor, but they do show that within the range of practice the total flow of energy is the same in copper conductors, whetner it be urged by alternate or by steady currents.

*Abstract of paper read before the British Association, at Newcastle-on-Tyne, in Section A., September, 1889.

Thermo-Electric Investigations.*

BY H. STROUD, M. A., D. SC.

According to the law of Magnus (1851) no thermo-electromotive force can exist in a circuit consisting of one metal, homogeneous in structure, provided there is no discontinuity of form nor abrupt variation of temperature.

Le Roux (1867) showed that a thermo-electric current is produced in a single metal, whenever there is dissymmetry with respect to the point of heating. Ritter in 1801 obtained currents by bringing hot and cold wires into contact. No experiments appear to have been made on the E. M. F. produced when two portions of the same metal are in contact, and the one portion is kept at a high temperature and the other kept at a low temperature. Since a current flowing through a copper conductor, in which there is a gradual fall of temperature, in the direction of the current, has the effect of reducing the differences of temperature, we should expect the contact of hot and cold copper to give rise to an E. M. F. in such a direction as to tend to reduce the difference of temperature, *i. e.*, from hot to cold. Similarly, if two identical iron conductors are placed in contact, the one being kept hot and the other cold, we should expect analogous results; but the direction of the E. M. F. would be opposite as the Thomson effect is negative.

Several experiments were made with copper and iron tubes, great care being taken to have the conditions as favorable as possible, with the following results:

1. The direction of the E. M. F. is opposite in the case of the two typical metals, iron and copper, being from hot to cold across the junction in the case of copper, and in the reverse direction in the case of iron.

2. The magnitude of the E. M. F. is very much greater for iron than for copper, which corresponds to the much greater slope of the iron line in the thermo-electric diagram.

3. The magnitude of the E. M. F. is, for the case of iron and within the range of the experiments, proportional to the abrupt difference of temperature on either side of the point of contact.

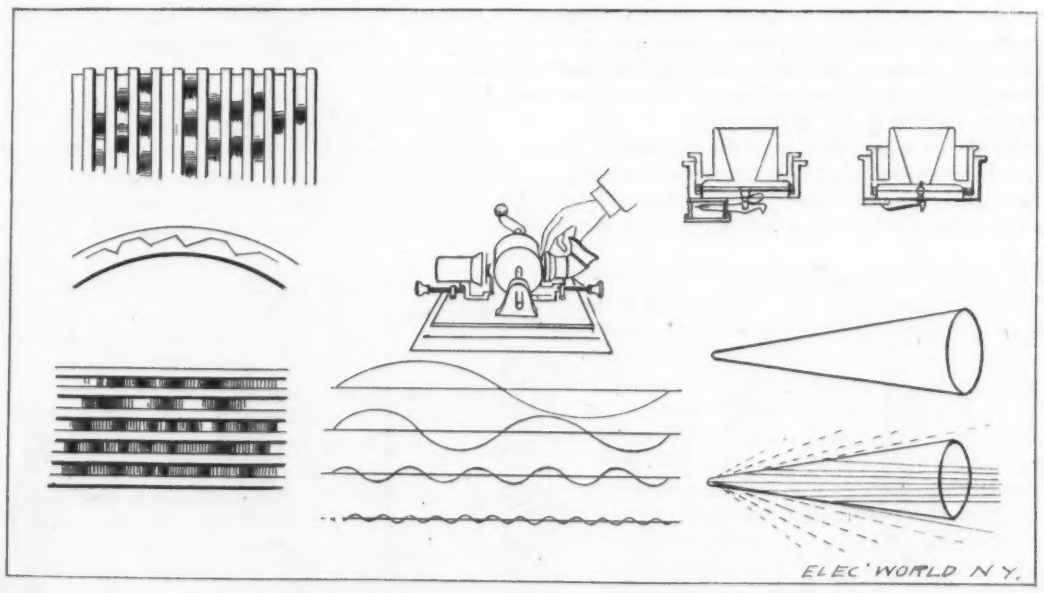


FIG. 29.—DETAILS OF PHONOGRAPH AND ITS RECORD.

*Abstract of a Paper "On the E. M. F. Produced by an Abrupt Variation of Temperature at the Point of Contact of Two Portions of the same Metal," read before the British Association, at Newcastle-on-Tyne, September, 1889.

Putting Instruments in Circuit.

To the Editors of The Electrical World:

Will you kindly inform me the way to connect a voltmeter and ampèremeter to an alternating current dynamo? A READER.

EAU CLAIRE, Wis.

ANSWER.—A voltmeter must always be connected as a shunt to the two points whose difference of potential it is desired to measure. An ampèremeter must be connected directly in the circuit in series to measure the current flowing therein. The instruments must not be employed for potentials or currents greater than they are designed for.—EDS. E. W.

Alternating Current Motors—The Evolution of a New Type.*

BY LIEUT. F. JARVIS PATTEN, U. S. A.

On giving our Secretary the title of this paper, it was my purpose to treat the subject in a broader light, and to show the progressive steps in a series of experiments which led eventually to the type of machine that I shall bring to your notice this evening. The recent and urgent claims of other work have rendered such a treatment impossible at the present time, and I shall limit the paper to a description of a new alternating current motor, one form of which is shown in the accompanying drawings.

The place that the alternating current electric motor is destined to fill in the industrial arts is familiar to you all, and the various ways known to the scientific world by which such machines may be rendered operative have been ably considered and elaborately discussed in the Institute papers of the past two years by Professor Thomson, Dr. Duncan and Mr. Tesla. We are thus all more or less acquainted with the prominent difficulties of the problem.

My experience in common with that of my predecessors teaches that the alternating current motor has a strong and persistent disposition to stand still, and when persuaded to motion it is apt to be a sort of "go as you please" machine, and asserts its inherent right to turn in either direction indifferently, direction of rotation in some cases being purely a matter of chance. I shall not have much to say about efficiency, as my experiments with large machines are not sufficiently advanced to furnish any reliable data, but I will endeavor to give a general solution of the problem designed to meet the following conditions of practice:

1. A machine that will start itself independently of the speed of the generator or number of alternations of current per unit of time.

2. A machine that has but one direction of rotation, and cannot reverse under any conditions of current alternation.

3. A machine that is not necessarily synchronous with the generator, revolution for revolution.

4. A machine in which reversals of current direction do not produce corresponding reversals of magnetism in any iron part, when the machine is in motion at its normal speed and maximum efficiency.

5. A machine of simple form having an ordinary continuous wound armature revolving in a single or two-pole field.

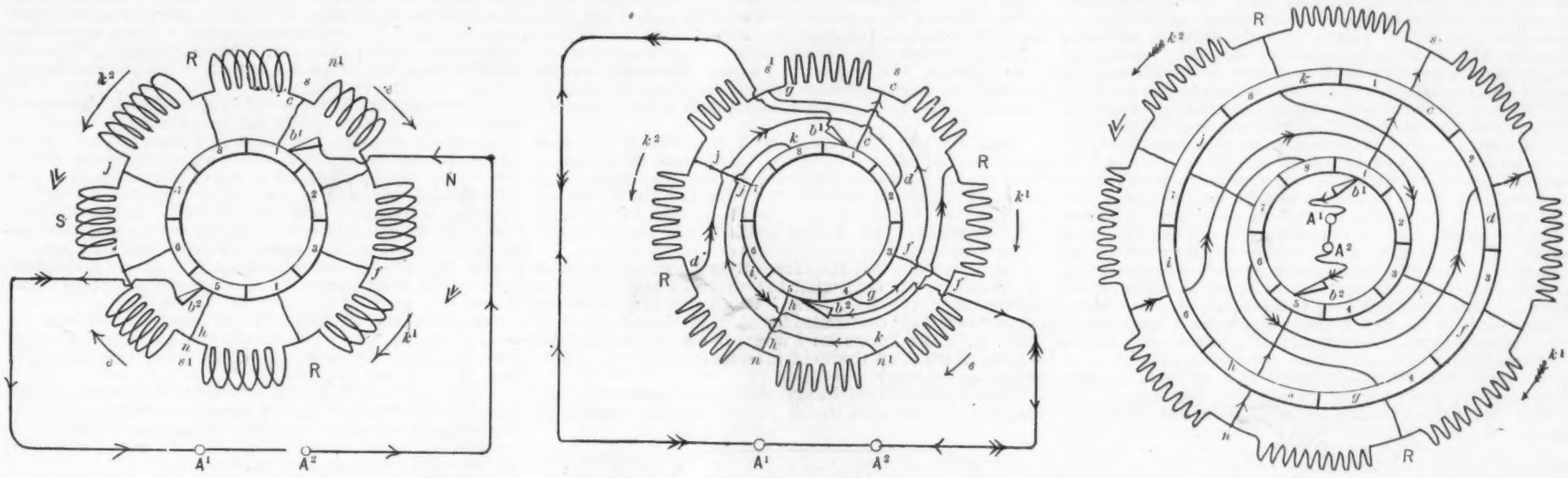
Referring now to the figures which are simply diagrams of the circuits and operative parts, we have in Fig. 1 an ordinary closed circuit armature shown as a Gramme ring merely for convenience of illustration, the points of the winding intermediate between the eight coils being connected in the usual way to the eight segments or bars of an ordinary Gramme collector, and it may be well in passing to note here the functions of this collector. It is not a commutator in the strict sense of that term, as it does not rectify or redirect the reverse or opposed currents. If the brushes b^1 and b^2 were held upon the outside wire of the ring the same results would follow, and the Gramme collector properly so-called simply transfers the brush contact from point to point of the continuous ring winding. If a source of direct current be interposed between the terminals A^1 and A^2 current will flow continuously from brush b^1 to b^2 downward through the right and left hand halves of the ring in the direction of the arrows k^1 and k^2, making say a south pole in the ring at the upper point S, and a north pole at the lower point n. With a continuous current these poles would be continuously maintained, and placed in the magnetic field indicated by N and S, the armature would continuously revolve in the direction indicated by the arrows e e. If now a source of alternating current be inserted between the terminals A^1 and A^2 the polarities of the ring would be reversed at each successive alternation of current, and if a direct impulse indicated by the single arrows in the external circuit produced the poles n and s in the ring, the reverse impulse indicated by the double arrows would produce the opposite polarities n^1 and s^1 at the same points, and the tendency to motion would be reversed if the fields remained the same; but it will be noted the motion would be in the same direction still if the fields were also reversed by the same reversal of current. If, however, the fields were maintained constant, as indicated by the large letters N and S, and some device could be contrived by which at each reversal of the alternating current, the brushes b^1 and b^2 could be made to change position, either mechanically or otherwise, then with an alternating current a constant polarity s and n would be maintained at the upper and lower points of the ring, for then a direct impulse starting from A^2 to the right would enter the ring through the brush b^1; flowing down both sides in the direction of the arrows k^1 k^2, out through brush b^2 and back to the source at A^1. The reverse impulse indicated by the double arrows would start from A^1 to the left, going to brush b^2; and if we now suppose this to have changed places with the brush b^1, the reverse current would then enter the ring at s, and flowing down both sides in the direction of the arrows k^1 and k^2, would leave through n and the brush b^1 and so back to the source a^2, maintaining the polarity of the ring the same as before. If the brushes could be thus changed at each alternation, the polarity of the ring would be maintained constant with an alternating current. While, however, it is quite impracticable to thus cause the brushes to change position mechanically at each reversal of current, it is perfectly feasible to produce the same effect without the mechanical change. The means of accomplishing this result are indicated in Fig. 2, which is identical with Fig. 1 with a single exception. There are eight coils as before, and eight bars in the collector. The odd numbered bars 1, 3, 5 and 7 are connected to the same points of the ring as before, c, f, h and j, but the even numbered bars 2, 4, 6, 8 are connected respectively to points of the ring diametrically opposite them, bar 2 to the point d, bar 4 to the point g, and so on, each even numbered bar to a correspondingly opposite point of the winding. If now a source of alternating current be interposed between the terminals A^1 and A^2, and we make the single supposition that the ring shall turn through an arc of the circumference equal to that covered by one bar of the collector during each alternation of current, we shall still maintain a constant polarity at the upper and lower points of the ring, without causing the brushes to change position mechanically.

Thus a positive impulse, starting from A^1 to the left, and indicated by single arrows, enters the ring at b^1, flows down both sides to n, producing the ring polarities s and n, out brush b^2 and back to source at A^2. The reverse impulse, being in the opposite direction, will start from A^2 to the right, go to brush b^2, which we will now suppose bearing on segment 4 of the collector, whence it will go by the inverse connection to the opposite point s^1 of the ring, then down both sides in the same direction as before to the point n^1, then back to the opposite segment 8, out brush b^1, now bearing on this segment, and back to source at A^1.

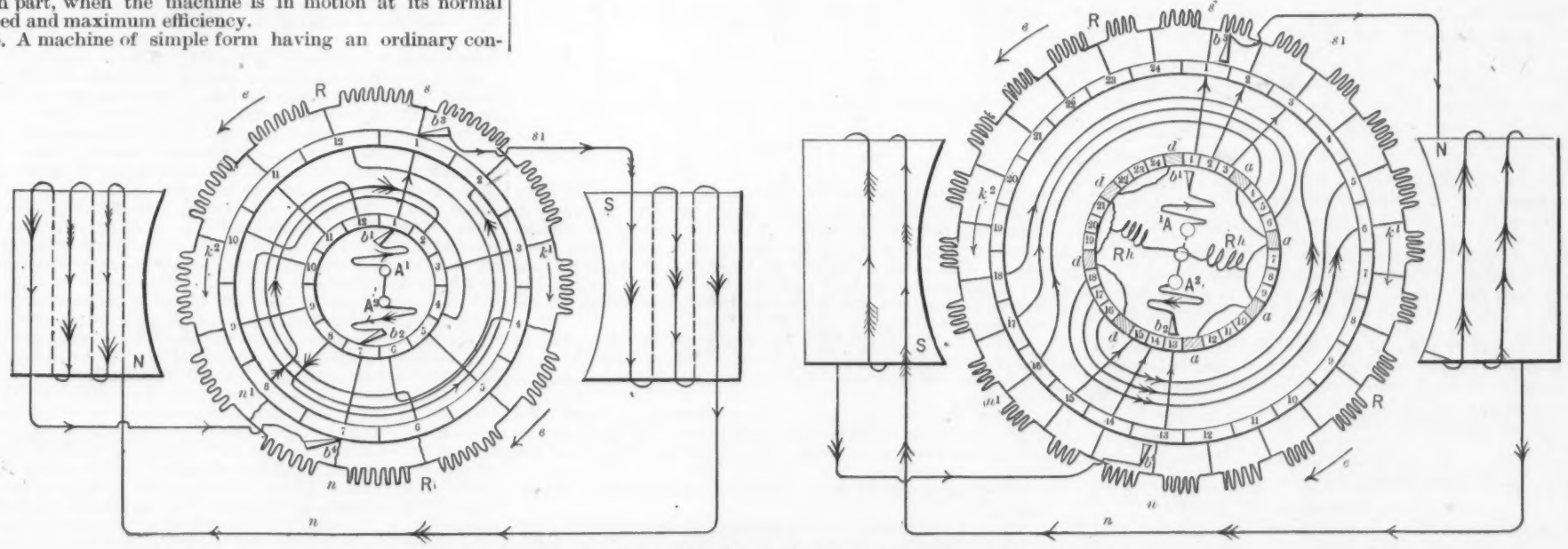
The reverse currents, therefore, under the assumed conditions are caused to maintain a constant polarity in the ring, so that in a constant field its tendency to motion would always be in the same direction with an alternating current in the armature. It will be further noted that the alternating current is not redirected or commuted in the strict sense of the word, and we may enunciate the fundamental principle which underlies the construction of this type of machine, as follows:

"*The poles of any closed circuit may be maintained constant with an alternating current by causing opposite impulses to traverse the circuit in opposite directions.*"

The direct and inverse connections, shown in Fig. 2, have precisely this effect, when, as supposed, a single bar of the collector passes under the brushes at each reversal of current. The connections $c\,c$, $d\,d$, $f\,f$, etc., in Fig. 2 may have any form, and other bars may be interposed between their extremities without affecting in any way their functions as connectors. This step is shown in Fig. 3, where another collector bar, 1c, 2d, 3f, etc., is inserted in each of the connections, $c\,c$, $d\,d$, etc., of Fig. 3, thus making another collector, shown outside the first to avoid confusion of the drawing; while for the same reason the source of alternating current, A^1, A^2, is placed inside the inner ring. As the polarities s and n of the ring are maintained constant, as previously described, with an alternating current, and the current is constant in direction from s downward through the right and left halves of the ring to n, so must necessarily any current be constant in direction which is led from brushes through any shunt circuit connected to the segments 1c and 5h of the outer collector; a field circuit of constant direction may therefore be shunted from this outside collector. This is shown in Fig. 4, in which twelve coils are shown in the ring and twelve bars in each collector connected alternately direct and inverse as before. Tracing now two opposite impulses of current, we have the first indicated by the single arrows from source A^1 to segment 1 of the inner collector, thence to segment 1 of outer collector, where the current divides, part going down the right and left hand halves of the ring to n and part out brush b^2 through the field circuit, making the poles N and S back to brush b^4 segment 7 of outer and segment 7 of inner collector to the terminal A^2 of source. If the armature be supposed now to turn through the space covered by one collector bar, the reverse impulse can be traced as follows, starting at A^2 in the opposite direction to brush b^2, now bearing on segment 8 of the inner collector, thence through the reverse connection to segment 2 of the outer collector; now under brush b^2, where the current divides, going part as before down the right and left halves of the ring, mak-



FIGS. 1, 2 AND 3.—THE PATTEN ALTERNATING CURRENT MOTOR.



FIGS. 4 AND 5.—THE PATTEN ALTERNATING CURRENT MOTOR.

* Read before the American Institute of Electrical Engineers, Sept. 10, 1889.

ing a south pole at s^1 and a north pole at n^1, as before, and the other part out of brush b^3, through the field circuit in the same direction as before back to brush b^4, now on segment 8 of the outer ring, thence through the reverse connection back to segment 2 of the inner ring, now bearing on brush b^1, and so returning to the source at A^1. Thus the two impulses of opposite direction have been made to traverse both armature and field circuits in the same direction; we have therefore with an alternating current constant armature polarity and constant field polarity, and therefore a constant tendency to motion in the same direction. Not only this, but the further condition is fulfilled that there are no reversals of magnetism in any iron part, so long as one bar in the machine, as shown in Fig. 4, passes under the brushes at each alternation of current. It remains to show how this is brought about. Referring again to Fig. 4, let it be supposed that the first impulse of current did not cause the armature to turn through the arc of the circumference subtended by one segment, but all the brushes still bore on the same segments as shown in the figure, and the reversals of current continued; by tracing the circuits it will be seen that each reversal of current reverses the polarity of both field and armature, and with either direction of current or rapid reversals there will be a constant tendency to motion always exerted in the same direction. The machine under these conditions becomes therefore simply a direct current machine on an alternating current circuit, with a constant tendency to start in one direction. Assuming the machine therefore self-starting, it will continually gain in speed until the condition is fulfilled of one segment passing the brushes at each alternation, for it then becomes in the broad sense a synchronous alternating motor. The current then produces no reversals of magnetism, and there is a true alternating current in the armature circuit, producing, however, no reversal of armature polarity, and a current of constant direction in the field. Under these conditions the motor is self-regulating, moving at a constant speed with a maximum rotary effort.

It is not, however, essential that one bar should pass the brush at each alternation, as any number may be caused to do this, depending upon the speed required and the number of coils upon the armature. This is illustrated in Fig. 5, where the complete machine is shown. There are 24 coils in the armature, 24 bars in the outside collector, and 32 bars in the inside one, this latter being composed of 24 connecting and 8 insulating bars. The connecting bars of the inner ring are numbered to correspond with those of the outer ring around to the right from 1 to 24; the insulating bars drawn shaded separate the others into groups of three. In this machine three segments, 1, 2, 3 in the outer ring, are connected direct to the corresponding segments, 1, 2, 3 of the inner ring; likewise the opposite three, 13, 14, 15 of one ring, are connected direct to 13, 14, 15 of the other. The next group of three is connected inversely, 4, 5, 6 of the outer ring to the diametrically opposite bars 16, 17, and 18 of the inner ring, and the corresponding opposite group 16, 17, 18 of the outer ring are likewise connected inversely to the diametrically opposite group 4, 5 and 6 of the inner ring. The remaining segments are connected in the same manner, but the connections are omitted to avoid confusion of the drawing The operation of the machine is evidently the same as that shown in Fig. 4, except that the required conditions are fulfilled in this instance when three bars of the collector pass under the ring at each alternation of current, and as there are twenty-four segments arranged in groups of three, the machine at its normal speed would make one revolution for every eight alternations of current and connected in a circuit supplied with 16,000 reversals per minute, its normal speed would be $\frac{16000}{8} = 2{,}000$ per minute, and with 48 segments arranged in groups of three its speed would be 1,000 per minute. The blank segments insulating the groups of the inner ring are connected to the extremities of a rheostat, *Rh Rh*, which is inclosed inside the commutator, and is designed to offer a path for the alternating current, such as there may be, and prevent its absolute rupture at the period of change from one group of segments to the next; they also serve an important purpose in preventing a dangerous short circuit which would be occasioned by the inner brush bridging two groups of segments oppositely connected.

It follows, as a matter of course, that as the machine starts as a direct current motor connected in an alternating circuit, rapid reversals of magnetism will at first be produced in all the iron cores, and these should be made of laminated iron, to prevent undue loss by heating at the period of starting. The machine, in fact, starts as a direct current motor and automatically changes to a sort of synchronously alternating motor. When it gains its normal speed at this point it is self-regulating, and its capacity of doing work is a maximum.

Fig. 6 shows a plan of the machine as constructed. It consists simply of an ordinary closed circuit armature in a single field; *c c* is the ordinary collector, really a part of the armature circuit from which the brushes b^3 b^4 take a current of constant direction to the field shunt; *a c*, *a c* is the reversely connected commutator, and the brushes b^1 b^2 bearing upon this commutator are connected to the terminals of the alternating current circuit.

DISCUSSION.

Lieut. PATTEN: I might add to the paper the fact that the inner commutator, the one which is the ordinary commutator of the Gramme ring winding, does not perform the ordinary functions, as the brushes bearing on this collector require no adjustment, it being merely a rubbing contact from which the shunt field circuit is taken as a derivation to the main circuit of the machine.

Mr. C. O. MAILLOUX: I would like to ask Mr. Patten whether sparking occurs to an injurious extent.

Lieut. PATTEN: The sparking due to the electromotive force at the point of breaking will occur during starting, and especially when out of synchronism with the alternating current, as the alternating current is liable to be broken where this electromotive force is high; and the sparking would be very violent. The device to obviate this is shown in Fig. 5. If the brush comes on to one of the shaded segments connected with the rheostat before the alternating wave has come to zero, it finds a path at first in parallel with the machine circuits and then a separate path for the alternating current during its change, whether at a high or a low electromotive force. In starting, this may happen at any period of the wave, and the brushes passing over these segments connect with the resistance at the end of the group, and before it has left the group the current is already short-circuited through this rheostat.

Mr. R. S. DOBBIE: I would like to inquire whether the field lamination is necessary only while the machine is starting or before the synchronism is attained, and if the maximum torque of a machine is at one-third speed, what comparison is that to the torque of the same machine at full speed when the synchronism is attained.

Lieut. PATTEN: There is no essential reason for laminating the field magnets for any other purpose, except that a laminated machine has a very definite neutral line of field, which makes it better for taking the direct current shunt for the field from that point without making two sets of brushes movable instead of one. The torque of such a machine depends entirely on its keeping in synchronism, and the result of departure from it is well known to all. That is the limit of the strain that can be exerted, and when exerted the machine will stop.

Mr. DOBBIE: My reason for asking was to find out if the motor will start on full load.

Lieut. PATTEN: No. It will not.

Mr. LEMUEL WM. SERRELL: I would like to ask how the currents are short-circuited through the rheostat when its ends are connected to the insulator blocks in the commutator.

Lieut. PATTEN: The question is a pertinent one, inasmuch as the term "insulated" was used in the paper. They are not insulated segments in the true sense of the word. They are all connected together and are of conducting material. Similar to the others but isolated from them.

Mr. SERRELL: The shaded portion indicates a metallic connection separated from the rest of the commutator.

Lieut. PATTEN: No; they are simply segments, the same as the others, but connected to an interior rheostat not in the circuit of the machine. I think that they should be called "isolating" segments instead of insulating.

Mr. H. WARD LEONARD: I would like to inquire whether the interruption of the field current occasions any loss of energy or heating?

Lieut. PATTEN: I might say that my experiments have been very limited, and that it would require considerable

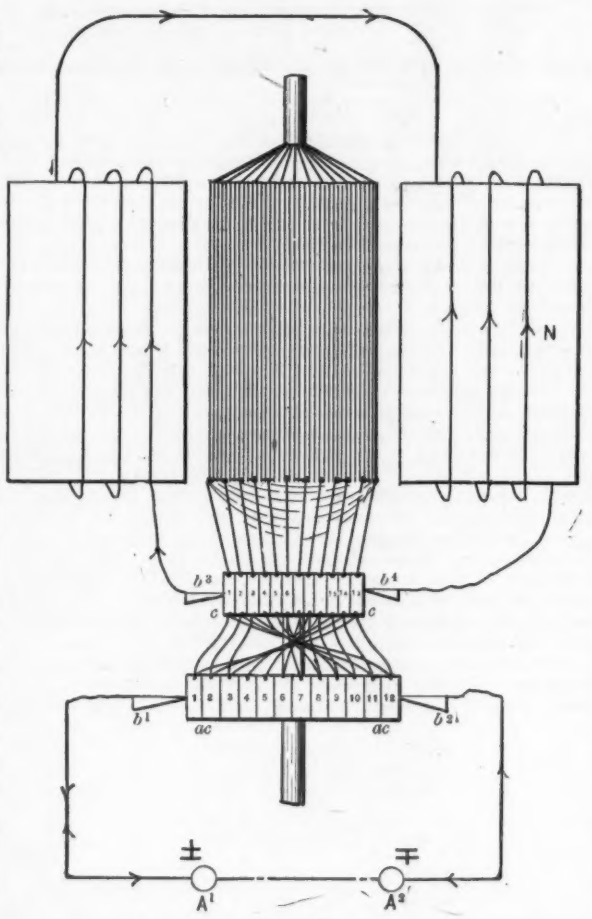


FIG. 6.

investigation to determine that point definitely. I have no doubt that it does limit the action of the field, but to what degree I do not know. But the current is broken when the machine is in synchronism at a point near zero value. Of course, at 16,000 alternations per minute the interruptions are so short that the field could not readily lose its magnetism, but whenever there is a break of the current there must be some slight loss.

Dr. ALLAN V. GARRATT: Another question in regard to the rheostat: Is its resistance obtained by experiment? And if so, what relation does it bear to the resistance of the machine?

Lieut. PATTEN: So far, I have attempted to make the rheostat simply equal to the resistance of the machine, so that there would be as little change in the strength of the current as possible.

Mr. MAILLOUX: Is the resistance reactionary or simply dead?

Lieut. PATTEN: So far the resistance in the commutator is a dead resistance simply. It might theoretically be made to advantage of the reactive kind.

Mr. MAILLOUX: I should think that a machine of this kind would be open to a defect from the current being a wavy one, no matter how rapid the periodicity, causing an oscillatory magnetism. If the magnetic core is laminated and of soft iron, I think it would rise and fall rapidly enough to follow the fluctuations of the current, as in transformers. Of course, there is a slight reaction in the substance of the iron itself, its "viscosity," due to hysteresis; at the same time it is not sufficient to interfere with the rise and fall of the magnetism, and the more perfectly the core is laminated the more rapid the rise and fall, causing a loss which would be quite material under certain conditions, and also loss due to the reactions following from mutual induction in the armature itself, because, even at synchronism, the current would be wavy, and is reversed through the coils. I should think this loss on account of the permeability and susceptibility, such as the armature core has, would be very important, and that a motor built on that principle would not show the efficiency which we might expect from other forms, as suggested by M. Leblanc and Mr. Mordey.

Lieut. PATTEN: I have only to say in reply that there is one evident misconception about the direction of current in the armature circuit. It is always the same. With reference to the induction due to its rise and fall, such loss is contemplated, and it is difficult to make out of an alternating current anything that does not vary. The essential fact, however, is, that the current at work is due not only to the maximum and zero values of the electromotive force exerted, but to the current which is the result of the mean electromotive force, and that is the electromotive force out of which we desire to get the work. I do not recall any machine described by Leblanc, except Mr. Tesla's and Prof. Thomson's earlier form of motor. Beyond them I do not remember any machine in which these difficulties are not equally present.

Mr. E. P. CLARK: I do not think that the rise and fall has very much influence in that, because when the armature is revolving rapidly, it is the same as a continuous current dynamo. As long as the speed is constant the current will be very nearly the same. There will be very little rise and fall to it, due to the rise and fall of the alternating current.

Lieut. PATTEN: The current in the field will necessarily be a redirected one, represented graphically in the form I have drawn (Fig. 7). The commuted current at work, or the electromotive force, to speak more strictly, would be cut off at the point *a*, we will say; if the machine is in synchronism at points a^1 and a^2, the interval would be a period of no current. The loss spoken of by Mr. Mailloux will exist during such a slight period of no current whatever, as occurs at this point between here and here. I think that a solid field would not give up its magnetism during that short period. A closely laminated field might do so.

Mr. LEONARD: I should like to ask if you increase the load of the machine without fully loading it, and the load is removed, whether it would not race, and the reason why it should not run away.

Lieut. PATTEN: The limit of load is that which would throw it out by a full quarter period, and this is reduced to a quarter of a group of segments. If the load is lifted off, it cannot, unless the conditions of current change suddenly, go beyond its ordinary synchronous rate.

Mr. LEONARD: Can it race?

Lieut. PATTEN: I think not. The tendency, of course, is if it races to go to the double synchronism. It has to go to the double speed or the quadruple, or else at the single speed at which it is synchronous.

Mr. MAILLOUX: I do not think that Lieutenant Patten has made quite clear the reason that would tend to maintain the speed constant when the load is altered.

Lieut. PATTEN: The action is the same as that of an ordinary alternating current motor where its maximum electromotive force is exerted when it is in synchronism within a quarter period of that of the generator. If overloaded, it comes to rest, or short circuits the armature—burns it up.

Mr. E. P. THOMPSON: The question has occurred to me what kind of a current would be produced in the outside circuit if the armature were rotated, and whether this motor is also a dynamo.

Lieut. PATTEN: I have never driven the machine backward, but I discussed this question with Mr. Seely in the Patent Office, and it was first supposed by him that the machine was not a "dynamo and electric motor," as I had termed it in the specification. But we finally came to the conclusion that it was. The chief objection is that a self-exciting dynamo must have a continuous current to excite its field, and it must be an increasing current. The unfortunate thing about this machine is that it has not an increasing current. The question arises as to whether there would be a sufficient continuity of current in the machine with this shunt circuit to make it a dynamo. I think it would be a dynamo, but of small efficiency.

Mr. LEONARD: I should like to ask Lieut. Patten if he would kindly give us some description of the performance and sizes of the machines.

Lieut. PATTEN: Those I have made are too small to give any data which would indicate any efficiency worth talking about.

Mr. LEONARD: What voltage did you work upon?

Lieut. PATTEN: One hundred volts. I will draw the Mordey machine, and show the difference. (Fig. 8. was placed on the board). The device for rectification is fixed on the spindle represented by the dotted line of the moving machine. The commutator of an ordinary armature is shown here. This being the armature circuit, we will trace it simply as a closed coil from the upper point to the opposite point of the commutator and thence to the field. On the same spindle with the armature is placed another commutator, which is shown here in two parts. The upper and the lower halves are separated by isolated segments connected to a rheostat such as I have described this evening. It is shown this way, but in reality there are for each pair of segments a corresponding pair of isolating segments connected with the rheostat, so that after the brush passes one segment it circuits with the rheostat, and so on. At the bottom is the source of the alternating current. These terminals go to the brushes, bearing on the rectifying conductor which is broken up into alternating segments, part of them connected and part isolated. The live segments are connected alternately to two rings, say one-half of the segments to one ring and the other half to the other ring. Bearing on these rings are two brushes used as intermediate connections. Evidently this machine requires a speed of rotation such that the alternating current coming in at these two terminals will be commuted; then a direct current will flow from the brushes, bearing on the continuous rings, and from these brushes we have a direct current through the armature and field in series, back to the outer ring and so returning to the source of the alternating current. This is spoken of by Leblanc as one solution of alternating current motors. It is not an alternating current motor in the strict sense of the word, because the alternating current is commuted before it is put into the machine. It is open to the same objection, of course, that the alternating current is broken at the point where it passes zero value and the same remark applies to the field.

Mr. W. FORMAN COLLINS: When you break the circuit at the isolated segment the field will lose its magnetism. Will not the armature tend to act as a short circuit across the field on the current starting again?

Lieut. PATTEN: If the machine is in synchronism the current at this point is near zero, and the short curcuit is of little consequence.

Mr. COLLINS: It would tend to induce very heavy sparking.

Lieut. PATTEN: It would if it were not for the isolating segments on which the brushes then bear, and which offer a path for the current and so prevent its rupture.

Mr. COLLINS: Provided the field maintains some little magnetism.

Lieut. PATTEN: Yes; if it gives it up entirely, of course the reactionary effect would produce sparking.

Mr. DUGALD C. JACKSON: I should like to ask if all these schemes are not beating around the bush to get a continuous current motor, and if the size of the machine when put on practical circuits is not prohibitive, and that consequently we cannot get an alternating motor that will do the work on practical circuits economically.

Lieut. PATTEN: If we accept the gentleman's remarks as conclusive that would settle the matter. I shall have to refer you to future generations for your answer.

Mr. CHARLES J. REED: I would like to ask in regard to the action of these waves. As the potential varies from maximum to zero, suppose you have the normal speed, instead of reversing, the potential simply rises and falls from maximum to zero. Now, as that occurs at a certain speed, will not the iron completely lose its magnetism each time the potential falls to zero? I believe that in a converter the iron will actually become demagnetized about twenty thousand times a minute. If that is so, and you use a current having a less number of reversals than that, would not the magnetism actually become zero between each of those successive impulses? Would not the current actually vary from a certain maximum to actual zero?

Lieut. PATTEN: I would simply say that so far as my experience is concerned, I have seen magnets that change their magnetism as slowly as fifteen times a second and retain enough to act as small dynamos; that is very slow as compared with 133 reversals, which are used in this country, and down as low as 50 on the other side. But there undoubtedly is an approach to zero in the magnetic field, and there is at the same time a period of zero current in the armature.

Mr. REED: Would not your laminated field tend to have the magnetism actually become zero?

Mr. MAILLOUX: If we were dealing with a simple magnetic circuit in which there is no reaction against the lines of force in collapsing, then you would get a very quick loss of the magnetism, and possibly absolute zero in the interval between the two pulsations. For example, a magnetic circuit, in which all reaction against the lines of force is eliminated, would lose its magnetism instantly, as proved by experiment. Now, in this machine the armature core and conductors are in the magnetic circuit; consequently there is the reaction due to the conductors wound around both field and armature, and the currents induced in them by the rise or fall would tend to retard both the magnetizing and the demagnetizing, and I should think that it would be possible to so regulate the self-induction of the different portions of the circuit as to control that.

Dr. GARRATT: I would say that I confess that it does not seem to me that this question of field magnetism would be such a serious one. As I understand it, the only reason for laminating the field is to prevent undue heating at starting. We have spoken of lamination as though it were a fixed thing. It may mean breaking up the core into two or three pieces or into a million. I suppose that it would be simply necessary to so proportion the laminations of the field that its magnetization would not fall unduly, and so that in starting the machine the field magnets would not get unduly heated.

Mr. E. T. BIRDSALL: I think one point has been overlooked, and that is the action of different sizes. In small machines the magnet loses its power very quickly. But in large machines it takes from two to three seconds. We might arrive at a mean size which would give the best effect I think that possibly it does not matter so much whether the magnetism does fall, because everything else is zero at that time.

Mr. LUDWIG GUTMANN: I think the motor just described is very ingenious, but we have, of course, to consider it in connection with the circuit. It is a step forward, because it can be so arranged as to permit the introduction of motors of different speeds on the same circuit. Nevertheless, the motor is of the constant speed type, while in practice a variable speed is often desirable. The serious objection is that it has the high potential current in the motor armature itself, and in case of any trouble arising, the consumer who has to handle it is immediately exposed to the danger of high-tension current in the main wires. Otherwise, I believe it would answer many purposes, because the motor will do its work well. It appears that the motor would not start with any load on it, and would need a loose pulley so as to get up to synchronism before the load could be thrown on. I do not think that this motor can be worked at low tension on account of self-induction. If such a motor should be placed on an ordinary alternating current circuit of 1,000 to 1,500 volts, and there is any sliding connection and commutators to get loose, or brushes to wear out, we should always have to send practical and experienced men to the spot, and they would be exposed to to the thousand volt current, which would be objectionable.

Lieut. PATTEN: With reference to the high potential, of course in the general description the source of alternating current is represented as any, of either high or low potential. The current is presumably one of suitable character to meet the conditions in which it is to be used. With reference to the further difficulty mentioned, accidents will happen with any kind of machine, either direct or alternating, while the other forms of motor have some advantage in having ring contacts and sliding brushes that require no attention. The disadvantages that are introduced by bringing in the use of brushes are incident as well to the ordinary forms of motors with which we are familiar. We are not so familiar with the kind that have no commutators that we have got used to their ease and simplicity of working. The second set of brushes are not, as I have said before, brushes in the ordinary sense, and do not require adjustment and care. If a high potential machine is used, of course the ordinary precautions will have to be taken. It is not quite within the province of the alternating current motor to make the alternating current safe for everybody who uses it.

Mr. GUTMANN: To produce five or ten horse-power we need a certain number of ampère turns in the field, which entails a considerably higher pressure than might be supposed. We must have an armature to perform the work and to obtain the torque. Consequently I think it is impossible to realize a large amount of power without using medium or high-tension currents for alternating current motors. I should prefer a motor like Professor Thomson's, in which the high-tension current is fixed—no rubbing contact; and I think Mr. Tesla has shown us one way in which to construct a motor without commutator or brushes. As it stands, we have an increased self-induction, and we need a greater power and greater tension for this class of motor than we would if we had only to energize one of the two parts, and that is a serious difficulty in introducing it into ordinary use.

Lieut. PATTEN: I think the alternating current motor might be left for the present. As to making a rival to the continuous current motor, no attempt is made in that direction. The object is not to make a machine which has less weight and more efficiency at the outset than one that has been improved by the ablest talent of the world for the last five or six years. The question is radically whether or not we can make an alternating current motor at all. The question might be put, what are you going to do with your current ten miles from here, if you cannot get an alternating current motor? I think if the efficiency of such a machine drops to sixty per cent. it would not be a vital question in the problem with reference to the great importance of the transmission of power to great distances.

The CHAIRMAN: I am sure it has been a great pleasure to all of us this evening to learn from Lieutenant Patten how great and how rapid has been the improvement in the

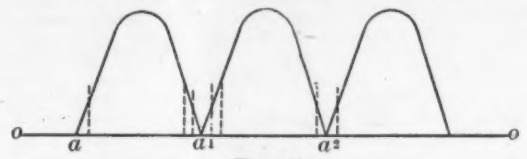


FIG. 7.

direction of giving us a practical and useful alternating current motor. I now have much pleasure in announcing that for our October meeting we shall have a paper by Mr. Thomas D. Lockwood, a member of our board of managers, who, having recently returned from a prolonged trip through Europe, has made a great many observations on electrical development there, and who purposes to lay before us the pith of his notes on the subject. The paper will be read in October.

Series Electrical Traction at Northfleet, England.*

BY EDWARD MANVILLE, M. I. E. E.

The expenses of horsing a tramway form such a serious proportion of the total working expense, that any cheaper effective method of propulsion will naturally be gladly received by the various companies.

Steam and compressed air have been extensively tried, but found wanting on account of the expense.

The cable systems have met with considerable success in the United States, and have achieved some measure of success in the United Kingdom.

Many leading authorities have of late publicly expressed their confidence in electricity for the purpose.

By running the motors in series, the maximum ease of manipulation, together with perfect safety to the motor, is attained. This was recognized at an early stage by the late Prof. Fleeming Jenkin and Profs. Ayrton and Perry, and the first electric locomotives ever run in series were used by them in connection with telpherage.

The subject of electrical traction has reached such a degree of prominence in this country that an electrical tramway on the series system has been constructed at Northfleet.

The essential parts are: An electric generator, producing a current of constant quantity and an electrical pressure varying continually, according to the total work being done by the whole of the motors together; the conductor taking the current from the generator to the motors, provided with automatic switches of such a character as to enable the continuity of the conductor to be broken as long as the motor is in electrical contact with the open ends of the conductor, and to be closed as soon as the motor, in passing away, ceases to be in contact with the ends of the conductor.

The generator used at Northfleet is one of Statter's. The current, after passing through the regulator, goes to a

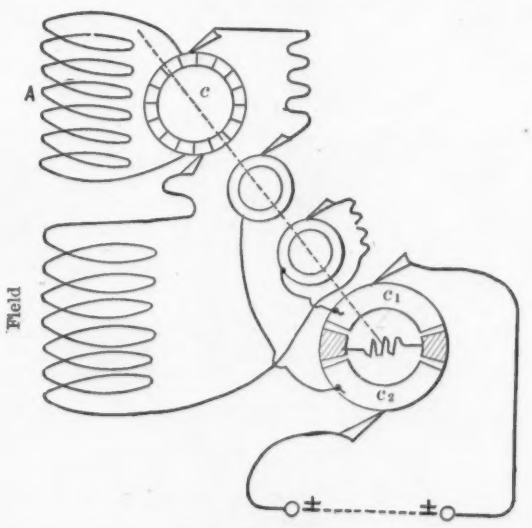


FIG. 8.

highly-insulated cable, reaching the whole length of the line. The cable is cut at distances of 21 feet along the line, and the ends of it are led into terminals connected with the opposite faces of a "spring-jack," which is at the same time the automatic switch and contact point from which the current is collected. From the last "spring-jack" at the end of the line, a return cable, with its insulation unbroken, is brought back to the other terminals of the generator, owing to the line at Northfleet being a single track.

The "spring-jack" consists of a pair of glazed earthenware blocks, 14 inches by 3 inches by 4 inches. To each block is attached, by means of a double spiral ring, a gun-metal casting, curved at the ends but flat in the centre. Under the car, and for its entire length, is the collector, or "arrow," which consists of two thicknesses of india-rubber belting, each having a broad brass strip riveted to it for nearly its entire length. The nose of the "arrow" at each end is shod with wrought iron brought to a knife-edge, so as to easily force its way between the two faces of the "spring-jack," which automatically close after its passage. The conductor on each side of the "arrow" is lapped round one end, and an insulated space is left, slightly greater than the surface of contact of the "spring-jack" near the extreme ends on opposite sides. By these gaps, the passage of the collector, from one "spring-jack" to another, is effected without short-circuiting the motor.

The motors, Elwell-Parker type series, wound, are run at 400 revolutions per minute, delivering 15 h. p. on the brake. This slow speed was adopted to do away with intermediate gearing between the motor shaft and the car shaft.

The motor pinion gears direct with a spur wheel on the car shaft in the ratio of 1 to 4¼. The gearing is double helical, with a view to noiseless running, and the working is most satisfactory.

The conduit through which the "arrow" travels, and in which the "spring-jacks" are situated, is formed beneath one of the running rails.

In series running, owing to the employment of a current of constant value, it is impossible to damage the motor by either too rapid starting or by reversing while running; indeed, it is a positive advantage when descending a hill to check the speed of the car by altering the field connections so that the armature tends to revolve in the opposite direction to that in which the car is traveling, as the power that would otherwise be lost in braking the car is actually added to that produced by the generator, and thus large systems, with many cars and varying gradients, would appreciably reduce the total power required and the consequent consumption of coal.

These advantages, combined with the efficiency of distribution as regards the percentage of power lost in the conductors, with, at the same time, but a low difference of potential at the terminals of each individual motor, may be regarded as the main advantages of series running.

* Abstract of a Paper read before the British Association at Newcastle-on-Tyne, Section G, September, 1889.

Annual Meeting of the New York Street Railway Association.

The seventh annual meeting of the Street Railway Association of the State of New York was held in this city at the Fifth Avenue Hotel, on Tuesday, Sept. 17, at which were present delegates from street railway companies all over the State. One of the principal topics to be discussed was the application of electrical power to street car work.

Mr. CHAUNCEY C. WOODWORTH, of Rochester, N. Y., the president of the Association, in his annual report, referred to the great progress that had been made in electrical power, particularly in the practical solution of the street railway problem by the overhead system.

Mr. MCNAMARA, of Albany, was to have prepared a paper on the subject of the electric motor. In explaining why he had not done so, Mr. McNamara said: "The subject which was selected for me did not fit me at all. In fact, it would be quite embarrasing for me to make any report of the electric motor. For more than three years the company I represent has been considering the subject of using the electric motor. I have been actively engaged for these three years in trying to find out what is the best electric motor in the market. You can very readily see, therefore, that it would be entirely improper for me to submit a report at this time. One of our members in the Western part of the State, after traveling from Boston to San Francisco, and from New Orleans to Montreal, has decided that the Sprague motor is the best motor in the market, and has adopted it. Our honored president has made a like investigation, and has come to the conclusion that the Thomson-Houston is the best motor in the market, and has constructed a road upon that system from Rochester to Charlotte. Another member has traveled even more, if possible, than those just mentioned, and has come to the conclusion that the Sprague motor is best adapted to street car work, and is now operating cars by that system. In all my experience I have been unable to get information from those using motors themselves. They will parade their cars before you and let you ride upon them, but when you go to the stable, they would rather not have you look at what goes on there, neither do they care to lift the traps and let you see whether the brushes are sparking or the motors working smoothly. They all say, 'It is working splendidly.' We are, up to this moment, depending for our information almost entirely upon the manufacturers of motors. It would therefore be very embarrassing if I knew anything about the electric motor to tell you."

President WOODWORTH then said: "We have built a road from Rochester to Lake Ontario, a distance of about five miles, using the Thomson-Houston overhead system, and, with the exception of the first week, while we were breaking in inexperienced hands, there has not been a hitch in the work. If any of you gentlemen will visit Rochester we shall be glad to show you our system and allow you to lift the traps off from our motors, visit our stables and repair shops, and show you everything. Everything is open—we have no interest in the patent, and there is nothing to cover up."

Mr. MCNAMARA, in reply to a question from the Chair as to whether any delegates were in attendance with the special view of getting information that would be of service to them in deciding which system to use, remarked that, being a truthful man, he would admit that his company in Albany had about come to the point where they are ready to treat with an electric company for the installation of an electric system to run their cars; that he regretted the fact that his position rendered the presentation of a report an embarrassing duty. He further said that he had just received a telegram from Albany stating that permission is at last granted to string wires and erect poles for an overhead electrical system, and he expected the road would before long be in operation.

Owing to the fact that Rochester has a Thomson-Houston electric railway, that city was chosen as the place for the next annual meeting.

An Explanation of "Browning."

To the Editors of The Electrical World:

I have read in your issue of Aug. 31 a letter from Mr. L. S. Day, Louisville, Ky., entitled "A 2,200 Volt Shock." Mr. Day appears to think that a workman who, while endeavoring to secure a loose wire in the binding post of an arc lamp in circuit with 43 others, allowed the wire to slip from the post, while one hand was on the post and the other on the wire, must have exposed his body to a pressure of 2,200 volts.

A moment's consideraton will show that such was not the case. To expose himself to a pressure of 2,200 volts, the workman would have had to take hold of the opposite

brushes of the dynamo. As it was, he exposed himself only to the pressure due to the difference of potential on the opposite sides of the arc, formed as the wire slipped from the binding post. This pressure would, of course, depend upon the length of the arc and the strength of the current passing through the arc. It is likely that before this arc became very long the man jerked one hand away from the binding post. He may have been exposed to a pressure of two or three hundred volts.

The hand holding the wire was probably burnt by the wire as it became hot through having an arc formed between it and the binding post. The workman's tongue was probably injured by his teeth.

Napanee, Sept. 14, 1889. C. Fessenden.

The St. Louis Electrical Exposition.

St. Louis, Mo., Sept. 17, 1889.

The annual exhibition of the local trades and industries was opened on the 5th inst. at St. Louis with two added attractions of some importance, the Verestchagin paintings and Gilmore's Band. The managers appointed Mr. Fred Whipple, of Detroit, manager of the electrical department, and assigned a section of about one-third of the basement at the lower end, adjoining the permanent steam plant, for the exclusive use of the exhibitors from the electrical industries. Within this space are gathered all pertaining to this interesting science, with the exception of two exhibits placed on the second floor, where the surroundings are far more pleasant and the atmosphere less oppressive during the evening, when the visitors crowd into the building. It is a subject of remark that exhibits of special character as, for instance, non-magnetic watches, should face a display of boilers, and that adjoining the exhibit of the phonograph gigantic steam pumps should be discharging water into a large tank. The electrical exhibit, while not exceeding the electrical display made in Chicago at the convention of the National Electric Light Association last February, has some interesting features. Over the entrance to both the north and south approaches to the electrical section large wooden banners have been suspended, on which the word "electrics" appears in fiery incandescent bulbs, presenting an attractive sign. A few of the booths are very prettily decorated, and from present indications the majority of the exhibitors will probably do considerable decorating during "fair week," when the city is usually crowded with visitors.

Novelties.—In strolling through the exposition one notices a few novelties, as, for instance, the illuminated fountain where water is pouring down over plain glass incandescent bulbs supplied with current from a Loomis dynamo. Also the cascade where water is flowing over sheets of colored glass behind which are placed Western Electric high tension arc lights with Loomis incandescent lamps distributed through the foliage in front. The Missouri Fish Commissioners have two large tanks holding various species of the finny tribe, in which incandescent lamps attached to waterproof wire are sunk and held down by weights, the display being a source of delight to the children who constantly crowd around the tanks. In the electrical piano, a small motor revolves a cylinder holding perforated paper that passes over a drum, allowing the hammers to strike the proper wires through the perforations. The same effect is secured by turning a crank or working a treadle.

Special Exhibits.

The Missouri Phonograph Company, of St. Louis have numerous instruments placed about the building, all of which are a source of attraction to thousands of visitors. Phonographic concerts are given in the upper hall, to enter which a slight extra admission fee is charged.

The Electric Date and Time Stamp Company, of St. Louis, present to every visitor a card descriptive of their office device showing the exact time to a minute that this display was noted, as well as the hour, the day of the month and of the year. A person's name, office address and other matter can also be added to a private instrument, and afford perfect protection against a certain class of errors likely to occur in all business houses. A. W. Gifford and H. H. Weruse, of St. Louis, are in charge.

The Writing Telegraph Company, of New York, have placed, through their Western manager, Mr. W. S. Rogers, of St. Louis, an exhibit comprising a writing telegraph exchange, similar in many respects to a telephone exchange, the subscribers all being connected to a central office. Each subscriber is furnished with a combined receiver and transmitter inclosed in a wooden case. On calling up a subscriber by telephone, should he not answer or be absent, the party calling will write his message, an exact reproduction of which the absent party finds at his instrument on his return. Another style of instrument shown is called the "wire writer." These instruments are designed to report sales of stock, ball games, races, etc. Instruments are placed in different parts of the city and connected with one master instrument on which the writing is done and which starts and stops the pens of all the others in unison. Mr. Rogers reports that business men are much interested in the system and that exchanges are being opened at various points. Mr. W. A. Roberts, of St. Louis, is the assistant operator.

The Non-Magnetic Watch Company, of New York, have secured space directly at the entrance to the electrical exhibit, and have the same handsomely carpeted and furnished. Show cases are so arranged that visitors in passing along either side of the space are attracted by the beauty as well as the value of the display, and Mr. Robert C. Hubbell, of New York, the gentleman in charge, has his time fully occupied in explaining the merits of the Paillard patent non-magnetic balance and hair spring. Watches of all values are shown, also some antique time-pieces carried in Holland in ancient days, and other solid, substantial time-pieces that were made long before there was a city on the banks of the old Mississippi.

The American Waltham Watch Company, represented by Mr. H. E. Duncan, have a handsome booth with canopy and raised dials, and, as usual, display many beautiful watches containing their non-magnetic movements. Among the novelties are "stone" watches of agate, quartz and sand; also many antique time-pieces that indicate the development in watch making since 1657 up to the present time, and which show the wonderful progress made more clearly than any description could. Mr. Duncan also has a collection of the jewels used in making the knife bearings to be found on all fine testing instruments. His souvenir is a handsomely illustrated copy on heavy paper of John Swinton's social study, "A model factory in a model city;" a model of the factory is also part of the exhibit.

Carbon Rods, Cups, Plates.

The Standard Carbon Company, of Cleveland, have a neat exhibit of carbon pencils or rods designed for almost every purpose for which carbon is used, from the thin needles for the experimental laboratory lamp of the inventor to the rod of sufficient diameter to carry the great volume of current requisite in the process of smelting, carbon brushes for motors, etc.

The Solar Carbon and Manufacturing Company, of Pittsburgh, have a handsome display of carbons of various shapes and sizes made from natural gas. Mr. H. E. Webb is in charge; is on the most friendly terms with every one present, and has captured several nice orders.

The Parker-Russell Mining and Manufacturing Company, have a representation of their trade-mark and the words "Sunlight Carbon" blocked in gold letters on a dark background with carbon points radiating out between the letters. Above is placed the firm name with the address beneath, in raised black letters on a white ground. At the base on neat tables are placed samples of pencils, plates, battery cups of peculiar shape, and other carbon goods manufactured by this enterprising firm. Mr. L. Parker, of St. Louis, is in charge of the exhibit.

The Findlay Glass and Carbon Company, of Findlay, Ohio, show carbon cups for batteries, etc., as supplied to certain manufacturers.

The Fidelity Carbon Company, of St. Louis, have the most extensive and unique display of carbon goods shown, a prominent feature being a fence made of carbon plugs and hollow pencils, with posts built up of carbon cells, inclosing the booth. John H. Finney and J. P. Fowden, the gentlemen in charge, are distributing handsome pipes and match safes to such of their callers as care to smoke, and every one interested in electrical matters should secure one as a souvenir, at least by mail if not in person. Cases of solid carbon pencils are shown, also cored carbons adapted to the various systems of arc lighting. In this booth are shown the exhibits of the Law battery and the Crowdus dry battery, the Fidelity company making the carbons used in each cell.

The Steam and Power Plant.

Boilers.—The steam required to operate the engines revolving the shafting to which so many machines are belted, is generated in a plant of four Heine water tube boilers of 250 h. p. each, erected in a separate station across the street from the main building, and in charge of Mr. Daniel McElroy.

The Heine Safety Boiler Company, of St. Louis, also have a 125 h. p. water tube boiler on exhibit in the electrical section, placed on their standard setting, with space on the side left open to show the main points of superiority and recent improvements that have been made.

Engines.—While every make of engine is not represented here, many of the leading ones are in operation through the kindness of the manufacturers who have placed them on exhibit. The engine plant owned and controlled by the Exposition Company was set up by, and is in charge of Joseph B. Bell, Chief Engineer. The power plant operating the electric lighting apparatus consists of two Armington & Sims high-speed engines, of 125 h. p each, placed by the Pond Engineering Company, of St. Louis, which are employed in driving Edison dynamos. These engines are in charge of Mr. F. W. Brendell, of St. Louis, who is also the assistant chief of the steam plant. A Buckeye engine of 150 h. p., purchased from the Buckeye Engine Company, of Salem, O., is in charge of Mr. C. C. Jennings, of St. Louis, and employed in driving two 400-light Edison incandescent dynamos. A Phœnix engine of 80 h. p., manufactured by the Dick & Church Company, is in charge of John Dillon, of St. Louis, and is belted direct to two 35-light Western Electric low tension arc dynamos belonging to the Exposition Company. Two Russell engines are in service, the one in charge of John Angell, driving the Heisler incandescent dynamos used in lighting the art gallery; and the other in charge of Thomas Campbell, is connected with two 35-light Western Electric low tension arc dynamos. The John T. Noye Manufacturing Company have placed a handsome Rice engine of 50 h. p. on exhibit, and are showing its value in electric light work by driving the 300-light Loomis incandescent dynamo in the adjoining section. David S. Tweed is the engineer in charge. The Kingsland & Douglas Manufacturing Company, St. Louis, have a Watertown engine of 35 h. p., and a 16 × 42 Corliss engine in charge of Fred Piening. The Westinghouse Machine Company, Pittsburgh, have a 35 h. p. standard engine driving a Blackman's exhaust fan and a 9 × 8 junior engine belted to a 400-light direct current Westinghouse dynamo. Benjamin F. Tendick is the gentleman in charge. A Sturtevant engine in charge of Mr. F. W. Gunn will shortly be in operation.

Electric Lighting.

Electric Light Apparatus.—The display in this line is not as large as might be desired. Aside from the electric plant owned by the Exposition Company, consisting of six Edison dynamos of 400 incandescent lights each, and four Western Electric dynamos of 35 arc lights each, in charge of D. J. Kelly, the variety of lighting apparatus shown is somewhat limited. In this connection Mr. Whipple states that several additional exhibits are now en route, and will be displayed before the close of the season. Mr. Whipple is strenuously endeavoring to make the display a success in every way, and deserves credit for having accomplished so much in so short a time.

The Westinghouse Electric Company, Pittsburgh, through their division manager, Guido Pantaleoni, are exhibiting a 750-light Westinghouse alternating current dynamo, with full complement of lamps, converters, etc., the entire plant being set up to represent a small electric light station in practical operation. The current is being used to light the lamps in the displays of the Southern Electrical Supply Company, Blatner & Adams, and the revolving pyramid of Greek maidens advertising the merits of various brands of beer. Some Tesla alternating motors will also be shown next week. F. P. Kinsley is in charge. A Westinghouse 400-light continuous current dynamo is shown in an adjoining booth, being of service in furnishing necessary current to the lamps placed in the arches at the entrance to the electrical display and to the display of the Phœnix Glass Company.

The Excelsior Electric Company, of New York, through their Western manager, F. W. Horne, of Chicago, have erected a handsomely trimmed booth of pink and white drapery, within which they are operating a 33-light arc dynamo, belted to a line of shafting that supplies current to several arc lights and to one 10 h. p. constant current Excelsior motor that drives a 75 ampère, 110 volt Excelsior incandescent dynamo, supplying current to many lamps arranged within the booth, and also to a 1 h. p. constant potential motor. Current from the large dynamo is also used to operate a 7½ h. p. constant current Excelsior motor that drives a five-arc light Excelsior dynamo. There are also shown samples of their new combination switch and rheostat for constant potential motors, the main feature of which is the screw movement and the closing of the circuit through carbon contact. The entire exhibit was installed by Mr. C. J. Reilly, of St. Louis, and is in charge of Mr. R. J. Randolph, of Chicago.

The Western Electric Company, Chicago, have an improved high tension 35-light arc dynamo and an incandescent dynamo operating one hundred and fifty 16 c. p. lamps on exhibition, which, taken in connection with the four exposition dynamos, gives the system a nice showing. Their high tension arc lamps are placed at various points about the building, notably at the spectacular display in front of the upper hall, behind the cascade, etc. The company also have an interesting display of house goods in a separate booth across the aisle, where are shown bells, batteries, automatic gas lighting apparatus, annunciators, etc. W. S. Bosley and H. C. Bullis are in charge.

The Kester Electric Company, of Terre Haute, Indiana, will display their incandescent apparatus later on, as referred to in a following paragraph.

The Ball Electric Light Company, of New York, have a 25-light arc dynamo and lamps at hand to be connected up, but have been delayed by non receipt of supplies. They expect to be in practical operation during the coming week.

The Heisler Electric Light Company, of St. Louis, are under contract to furnish six hundred 30 c. p. incandescent lights to the art galleries, and have in operation two of their improved machines, having polished wood casings, and two of the automatic regulators lately illustrated and described in The Electrical World. All the lamps are placed in series and each socket is supplied with the new automatic cut-out, which short-circuits, the current in the event of the carbon filament becoming defective. An improved form of house and office fixture and of their standard street fixtures are also on exhibit, the latter showing their method of street lighting with lamps placed at an average distance of 300 feet. Mr. Wm. H. Bryan, the secretary of the company, is in charge.

The Loomis Electric Manufacturing Company, of New York, have one 300-light incandescent Loomis dynamo supplying current to the lamps used in illuminating the cascade and fountain, and to several motors placed in the building. The company have also placed a total of 150 lamps in parallel rows on a board at the rear of their booth, the illumination of which proves an attractive feature, and near by are placed the various cut-outs, switches and other appliances used in operating their system. Huntington Lee, of New York, is in charge.

Electric Power.

Motors.—There is a marked absence of motors that is to be deeply regretted, and which can scarcely be accounted for on the plea that the manufacturers have too many unfilled orders on hand. It is with pleasure that I note that the manufacturers who have incurred the expense necessary in making a suitable exhibit have no cause to regret such action, as some five motors, aggregating 23 h. p., were sold during the first week as a direct result of the display, while numerous prospective orders are talked about.

The Excelsior Electric Company's interesting exhibit has already been referred to in a preceding paragraph.

The C & C. Motor Company, of New York, were represented by Mr. H. L. Lufkin, who strolled through the building with Mrs. Lufkin while stopping over for a day en route to California.

The Kester Electric Company, of Terre Haute, Ind., are exhibiting a 3 h. p. and a 5 h. p 110-volt constant potential motor. These motors will be driven by current from Kester generators as soon as the machines arrive, a 50-light and a 75-light Kester incandescent dynamo shipped for this purpose being delayed en route. The exhibit when complete will be an interesting one. The manager of the company, Mr. Hugh Robinson, and Mr. F. P. Cox, of Terre Haute, are in charge.

The Cleveland Motor Company, of New York, while having no regular exhibit, have placed one of their constant current motors in the exhibit of Prof. D. A. Kusel, of St. Louis, who has established a perfect optical factory in his booth. The motor drives the optical lathe used to fill oculists' prescriptions, a polishing stone and a grinding device, to the perfect satisfaction of all.

William Koedding, of St. Louis, has an excellent space wherein he is showing an improved form of street car motor inclosed in a miniature box car that travels along a raised track. No description is permitted, as patents have not yet been secured.

Julien F. Denison, of New Haven, Conn., has a 1½ h. p. 110-volt constant potential motor on exhibit that works very nicely on a current supplied by the Loomis dynamo.

Pearce & Jones, of New York, have a number of their revolving electrical turn tables both on exhibition and in use by other exhibitors.

The Jeffrey Manufacturing Company, of Columbus, Ohio, have a miniature coal mine built of blocks of coal on exhibit, in front of which is placed a Legg coal digger operated by the Bain motor recently described in the columns of The Electrical World. Tunnels, shafting, coal cars, tracks, etc., are all shown, making a realistic scene of great interest.

The Sprague Electric Railway and Motor Company, of New York, have one of their improved motors attached to a handsome Stephenson car that stands on a short stretch of track at the south side of the department. Every device tending to perfect the system and to add to the comfort of the passengers is here shown.

The Eddy Electric Manufacturing Company are exhibiting through their St. Louis agents, the Southern Electric Supply Company, two Eddy motors of handsome appearance.

The Westinghouse Electric Company, Pittsburgh, will have some Tesla alternating current motors on exhibit this week.

The Automatic Switch Company, of Baltimore, are displaying the Whittingham automatic switch, designed for use more especially on motor circuits, and having a spring attached to the handle in such manner that the action of starting or stopping is instantaneous. This switch is so well known to all your readers that any reference to it hardly appears necessary. In the "B" switch, designed for motors up to two horse power, the lever is actuated by quick throw springs connected with the handle, is controlled by a vibrating escapement governor, and, as with the large switch, the shutdown is instantaneous and without spark when the motor is running up to full speed. The inventors, Mr. G. Herbert Whittingham and Mr. R. H. Norris, of Baltimore, are the gentlemen in charge of the exhibit, and have placed their switches on all the motor circuits in the Exposition, thus giving the visitors every opportunity to test same.

Miscellaneous.

The Thomson Electric Welding Company, of Boston, have been delayed in arranging their exhibit through not receiving the generator, but will be in full operation this week, and afford to visitors a sight of the interesting process of welding, tempering, brazing, forging and shaping metals by the aid of currents of electricity. John T. Underhill, the business manager of the company, is present, with George F. Severs, an electrical engineer, of Boston. In addition to the large generator and three welding machines, the company are showing samples of every class of work accomplished, from the simplest to the most difficult, and are distributing a handsome souvenir in the shape of a polished rod of copper, brass, German silver and steel, all welded together so perfectly that no trace of joint can be seen. These souvenirs are highly prized by mechanics, who appreciate the value of a method that will join metals of such varied character together. In keeping with the high character of this exhibit is the draping of the booth in the national colors.

The Burton Electric Company, of Richmond, Va., occupy a booth that is visited by hundreds of housekeepers, who are now able to see how cooking can be done by the aid of electricity in place of gas, without any of the disagreeable features attending the use of the latter.

Various forms of cooking apparatus, some of which were illustrated in the issue of The Electrical World of Aug. 24, 1889, are shown by the inventor, Dr. W. Leigh Burton, who has also various styles of heating apparatus at hand.

The Phœnix Glass Company, of Pittsburgh and New York, has the handsomest exhibit of all, says a leading local paper, consisting of artistically-arranged incandescent lamps, to the number of 150, supplied with current from the Westinghouse direct current dynamo, placed to represent a combined star and circle. Attached to each lamp is a ring holding one of the artistic shades, no two being alike, for manufacturing which this company is noted. The effect, as seen from the opposite side of the hall when the current is turned on, is remarkable, and, being so very different from other displays, will long be remembered.

The Cole Conduit Company, of Detroit, Mich., are dislaying the Cole patent system of conduits for underground service, consisting of an outer casing of wood coated with a preservative compound and a series of interior wooden ducts saturated with paraffine, the space between duct and casing being filled with an insulating compound. A section of conduit is placed in a vat filled with water and "live wires" run through the ducts to show how thoroughly waterproof the interior is.

The Parrish Brothers & Peck Electrical Company, of Detroit, have a booth arranged to represent sections of two railway coaches wherein is shown their improved method of signaling to the engineer, as fully described in The Electrical World of Aug. 10, 1889. This system as applied to, and now employed on, the great lake steamers is also shown in practical operation. D. S. Skidmore, the St. Louis agent, and Frank Hutchinson, of Detroit, are in charge.

The John Stephenson Company, of New York, have one of their handsome street cars on exhibit, with Sprague motor attached. The car is finely finished, containing all the late improvements, and is admired by hundreds of visitors who peep into or pass through it.

The Butler Hard Rubber Company, of New York, are making one of the richest appearing displays in the entire building. Within a neatly draped booth are hung sample boards covered with orange plush, on which are arranged specimens of all their work, from large rubber cells for storage batteries to the rubber backs for hair brushes and mirrors. Samples of switch handles, key knobs, window tubes, telephone receivers and transmitters, magnet covers and heads, etc., are shown. Goods made of Kiehl's compound are so arranged as to attract special attention. William McKee and F. B. Hight, of New York, are representing the company and distribute some handsome souvenir cards in silver and black.

The Lockwood Instrument Company, of Detroit, Mich., have an exhibit of their fine ammeter and polarity indicator which has attracted so much attention owing to the simplicity and perfect adjustment. It is reported that the managers of the exposition have selected the Lockwood ammeter and polarity indicator for use on all the arc light and power circuits in the building. A higher indorsement could hardly be given.

Blatner & Adams, of St. Louis, have arranged a display of house goods in a booth on the main floor that is rendered quite attractive through the firm name, etc., being worked on a dark background with white porcelain insulators. Annunciators, batteries and bells are neatly displayed.

Mechanical.

The Improved Zigzag Grate Bar Company, of St. Louis, have a Boileau's rocking grate bar on exhibition.

The Garlock Packing Company's St. Louis office display samples of Garlock's packing, including the spiral and the sectional form and the elastic ring.

The St. Louis Fuel Economizer Company are operating a Heybrock shaking grate for the benefit of owners of steam plants, and also display a Gilbert crude oil burner. C. E. Lee, manager of the company, is in charge.

The Chalmers Spence Company, of New York, have a display of asbestos boiler and pipe coverings that are designed to be removable; various styles of asbestos packing are also shown.

The William Powell Company, of Cincinnati, are showing a full line of their oil cups, especially of the styles recently described in The Electrical World, which are extensively used on electrical apparatus.

The Pond Engineering Company, of St. Louis, win the blessings of exhibitors and visitors by making a large Hyatt filter do service in supplying clear ice water to all comers. The company have an exhibit of much interest to owners of steam plants, showing furnaces, pumps, belting, etc. Lee Duggan is managing the display, assisted by Gustave Raacke.

The Shultz Belting Company, of St. Louis, have the only complete exhibit in the belting line, a display that is of the most interesting character. The booth occupied is nearly at the right hand entrance to the electrical section. In the centre a workman is engaged in showing many of the processes through which a belt passes before completion. To his right convenient tables are placed for correspondence, while around the booth are piled belting of all sizes from the thin and narrow leather strip to the 48-inch double leather belt furnished to the Municipal Light and Power Company, of St. Louis. Various supplies used in connection with belting are also shown, and visitors are favored with a pamphlet containing many items of value to belt users.

The Stilwell & Bierce Manufacturing Company, of Dayton, O., have an exhibit interesting to all users of steam power, and also to parties utilizing the water power found so extensively in certain sections of the West. Within their allotted space is placed a large Victor turbine having two pairs of 12-inch wheels on horizontal shaft, with centre draft box, etc., of the same pattern now used by some thirty electric light companies. A 250 h. p. Stilwell's steam purifier is shown, being placed in position so that a complete view of the interior is obtained with the aid of a Loomis incandescent lamp; while a Stilwell's lime extracting heater and filter for exhaust steam is also shown. A pan containing carbonates and sulphates of lime taken from a purifier at Kingan's pork packing establishment at Indianapolis is exhibited; also, the deposits of lime and other impurities removed from the purifier of the city waterworks, Dayton, O., and graphically illustrated in The Electrical World. Mr. Day, of Dayton, is in charge of the entire exhibit.

Electrical Supplies.

A Combined Exhibit.—Probably the handsomest exhibit in the electrical department and the one most attractive to the general public is the combined display of the Southern Electrical Supply Company and the Central Electric Construction Company, both of St. Louis. Within their booth can be found a sample of almost every article in the supply line, while in front are pyramids composed of reels and coils of Okonite wire that form an entrance way to the booth, on the rear wall of which 153 incandescent lamps have been placed to represent the initials "C. E. C. Co." and the letters "O. K. O."; and lamps are arranged in the canopy covering the booth and on the posts supporting the same. In the show cases are displayed fine testing instruments, medical batteries, books, etc., while walls and counters are covered with samples of all improved devices used in installing electrical apparatus. The members of both these companies deserve great praise for the interest

shown in making so complete an exhibit and one that entails much expense and care.

THE STAR ELECTRIC WORKS, of St. Louis, are exhibiting samples of the Dawson patented invisible burglar alarm electric matting that possesses many excellent features not heretofore shown in the various circuit-closing devices employed. Mr. Dawson is in charge of the exhibit, and has the booth arranged to show how impossible it is for a burglar to enter a house where this matting has been properly installed without giving the alarm through the continuous ringing of an alarm bell placed in circuit.

THE CONSOLIDATED TEMPERATURE CONTROLLING COMPANY'S automatic heat regulating apparatus is shown to all visitors by their St. Louis agent, R. Gastang, who refers to the large number of buildings, both public and private, wherein the apparatus is in perfect operation and effecting great economy in the matter of fuel.

THE ST. LOUIS ELECTRICAL COMPANY, of St. Louis, deserve much credit for the enterprise shown in establishing a branch supply house within the building, where exhibitors could purchase such supplies as Grimshaw wire, lamp cord, cleats, etc., as were required in installing the various exhibits.

Batteries.

SECONDARY CELLS.—The entire absence of any exhibit of storage cells is criticised by many visitors expecting to have had an opportunity to inspect the merits of the various systems now on the market.

Primary Cells.

THE LAW TELEPHONE COMPANY, of New York, have a neat display of their new style of open circuit batteries, some of which are ready for use. The various parts are shown, also a sample of the fine grade of sal ammoniac used.

THE LECLANCHE BATTERY COMPANY, of New York, are exhibiting their A. X. O. porous cup cell, both complete and the various parts separately.

THE MICROPHONE CARBON BATTERY COMPANY, of New York, also have an extensive and interesting display of open circuit batteries, some of which are arranged to show the various uses in which the cells are employed.

THE ELECTRIC FARE BOX COMPANY, of Nashville, Tennessee, have an exhibit of their Crowdus dry battery showing various sizes, from the "Baby" to the "Jumbo," the smallest of which is attached through a short metallic circuit to a four-inch skeleton bell, which it loudly rings on closing the circuit with the aid of a push button. This company are also exhibiting their electric automatic fare box for street car use, which attracts much attention.

General Observations.

AMONG THE EXHIBITORS.—As a rule the various exhibitors have incurred no slight expense in making their respective displays. But it is doubtful if all are reaping as great a benefit as might otherwise occur if some plan were followed whereby the general public could instantly come to a more perfect understanding of the use for which various articles shown are designed. One of the prominent features of the exhibit of the Thomson Welding Company is he number of plainly printed placards indicating the nature and purpose of every article shown, whether it be the great generator, a link from a wrought-iron chain welded to a cast iron bar or a rod made by welding steel and German silver together. The visitor loses no time in asking idle questions that a placard can answer, and an intelligent interest is aroused. The carbon companies could place a card showing that the large black rods are used in the process of smelting by currents of great volume; that certain smaller pencils are made expressly for the "A. B. C." system; that one style of carbon cup is used exclusively in the Law battery, while the Crowdus battery employs a different shape cup, etc.

One of the most interesting exhibits in the entire section, and around which visitors are constantly crowding has scarcely an article tagged, and many a visitor has felt a disappointment in being unable to learn the name of and the use for which some article was devised.

To reap the full benefit of an exhibit, arrange the display so that "he who runs may read"—and buy.

HOUSEHOLD WORK.—As all modern residences are now wired while in course of erection for the various branches of electric service, it would appear as though an exhibit of a section of a residence showing the best method of running the various wires used would prove of interest to all property owners and architects, and would serve to educate the carpenter and the plasterer to a full appreciation of the utility of the wires and of the results that often ensue when a nail is driven through the insulation or a small wire is broken by the careless handling of a trowel. The same section of a house could be further utilized in displaying the method adopted in rendering a residence burglar-proof, and the convenience secured through employing a system of automatic electric gas lighting, etc., to say nothing of the more common call bell.

F. DE L.

Meeting of the Fire Underwriters of the Northwest.

The Fire Underwriters' Association of the Northwest held their twentieth annual meeting in Chicago last week. Among the papers read at Wednesday's session was an interesting one by C. C. Haskins, the city electric light inspector. The title of the paper was "Electric Lighting," Its hazards and how to guard against them. Among other points Mr. Haskins urged that no alterations should be allowed in a plant without notification. This is recommended as absolutely necessary as a measure of safety. Another point of danger largely overlooked is the practice, especially in smaller towns, of using improper places for the headquarters of an electric light plant. This oversight means a perpetual danger to life and property.

As a practical inducement to the electric light people to do their work properly, Mr. Haskins further urged that insurance companies address themselves to the electric companies by offering inducements in the event of a proof of lower risk, while on the other hand a carelessly erected plant should be held as entailing a higher rate against buildings wired by the careless company. Such a method would insure proper work.

In conclusion, Mr. Haskins said:

"The underwriter may help materially by refusing to write up a risk without some surety that the wires are in proper condition; by notifying the inspector when alterations are made in buildings, whether by carpenters, plumbers or otherwise. The most perfect plant may be ruined by a common helper without half trying or even knowing what he has done. These innocents have their place in the economy of the world. but, as a rule, they make inferior electricians."

Annual Meeting of the National Association of Fire Engineers.

The National Association of Fire Engineers held their seventeenth annual meeting at the Midland, Kansas City, Mo., last week. Among the papers presented was an able report, accompanied with graphic illustrations, entitled "Should not electric wires be run into buildings so as to insure safety from fires? also the best insulation for same," prepared by Capt. William Brophy, the well known expert of the New England Insurance Exchange, Boston, Mass.

Professor Barrett, of Chicago, made some interesting remarks regarding the "construction of fire alarm telegraph systems in municipalities." The Professor also spoke strongly in favor of underground wires, and of requiring electrical companies to have a representative at all fires where there is a possibility of having their lines exposed, in order that firemen and others may be protected from danger. Chief Edward Grill, of Evans ille. Ind., said that several of his men were shocked by contact with "live wires" at a fire in his city last July, and "knowing that electricity always seeks the ground, he at once had all three of his prostrated men stripped and laid on their backs in the mud of the streets, and that they were soon revived and are now well.'

The Shreveport, La., Railway & Land Improvement Company will probably use the storage battery for their five-mile road.

The Baltimore Celebration.—During the recent celebrations at Baltimore a parade was given in which the Postal Telegraph Cable Company participated, receiving quite an ovation. Twenty-five neatly uniformed messengers were led by a fife and drum corps, dressed in new Zouave uniforms. The float was handsomely decorated. There was a regular pole line, with eight large copper wires, two of the wires being guyed to an anchor of lilies and forget-me-nots, with the words "Postal Telegraph." The float was manned by F. J. Connor and a corps of operators sending dispatches. The scenery on the sides represented the Atlantic Ocean, with a cable of 100 wires from the United States to Europe.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Sept. 23, 1889.

The Electric Piano Company has been organized in Boston to manufacture and sell the electric pianos that have lately been introduced and have scored such a success at various exhibitions. The stock is, I hear, being quickly taken up.

The Phœnix Glass Company are making a most beautiful display at their salesrooms, 729 Broadway. It is a delight to the eye and a revelation of rare design and coloring. The show includes all the latest pretty fads in shades for incandescent lamps and all the newest ideas in cut and ornamental glass.

Mr. E. T. Lynch, Jr., consulting engineer and electrical expert, of 120 Broadway, has been actively engaged as expert on several electric railway and light plants in the West and a couple in New York State. Some of these plants will use storage batteries. Several large electric light plants that he has been consulting engineer for are also to use accumulators, and Mr. Lynch is giving his special attention to this branch of work at the present time.

The Cobb Vulcanite Wire Company, of Wilmington, Del., are meeting with excellent success in the introduction of their flexible hard rubber insulated wires and cables. Large quantities of these have been introduced in Chicago, and a considerable quantity has now been put in the New York subways for electric lighting and other uses. Mr. J. B. Ecclesine, Jr., is the New York agent, having offices and salesrooms at 45 Broadway.

Mr. Chas. M. Theberath, Ward street, Newark, is making a specialty of aluminum, phosphor bronze, brass, composition, German silver and white metal castings of all kinds for electrical apparatus. The shop was formerly one of Edison's, and Mr. Theberath has done considerable work for that exacting inventor personally, as well as for his company, and is familiar with all the requirements of electric lighting, telephony and the manufacture of instruments.

Pottstown, Pa.—Mr. John Meigs, of the Hill School of Pottstown, Pa., was the first person to take up the question of electrical lighting from a practical standpoint and equip his entire school with incandescent lights. This plant has been running for four years, and a marked increase has been noticed in the health, comfort and freedom from eye troubles among the scholars. Mr. Meigs has decided to extend his plant, and has contracted with Mr. E. T. Lynch, Jr., of New York City, to supply him with a large storage battery plant, thus doubling his capacity. The storage cells of the Julien system will be used.

T. F. Hunter & Co., 33 Church street, who are agents for the Electrical Supply Company, of Ansonia, and for Eddy motors, Clark wires and other specialties, are introducing the Orford pendants for incandescent circuits, to take the place of flexible cord for suspending lamps. This device has been illustrated in your columns. It gives a handsome finish and affords certainty to the insulation of the wires. It has already met with a large sale and promises to become widely introduced. The company also report that they have a great demand for the Paiste switches and that they are also in receipt of large orders for the Marr gas attachment and insulated joint.

The Goubert Manufacturing Company, 32 Cortlandt street, New York, makers of the Goubert feed-water heaters, and the noted Stratton separator, inform me that they have been furnishing the Brooklyn Street Railway Company, of Cleveland, O., with a 300 h. p. heater; the South Denver Cable Railway a 70 h. p. heater for the electric light plant; a 120 h. p. heater for the Columbia College electric plant; a 50 h. p. heater for the What Cheer Electric Light Company, Minn.; a 300 h. p. heater for the Yonkers Schuyler Electric Light Company, and a large heater for the Fargo, Dak., Electric Light and Power Company.

Mr. F. R. Chinnock, the agent for Long Island and New Jersey of the Edison and Sprague companies, is installing a 400-light plant in the works of the Ravenswood Cordage Company. This plant will be one of the finest in the country. It is to be run by a New York Safety Company engine, and will include two electric motors for carrying the bales of jute from the shop to the warehouse. Mr. Chinnock has secured a contract for lighting the Brooklyn Mills of the same concern. He has also been awarded a contract for lighting the oil works of the Lombard Ayres Company, Centreville, N. J. This will be a big installation. He will install 2,000 lights of 16 c. p., using the Edison three-wire system. The works cover a territory of 500 acres, and it is said that this will be the largest plant in the world for oil works. The Westinghouse engine will be used.

The Peckham Street-Car Wheel & Axle Company, of 239 Broadway, have for some time past been making a special study of the requirements of electric railroads. Their car-wheels and axles are now in use on a large number of railroads, including the West End at Boston and the roads at Scranton, Pa.; Port Huron, Mich.; Elkhart, Ind.; Jamaica, N. Y., and others Mr. Peckham has also devoted some time to the question of trucks, and has brought out a new electric motor truck which was recently illustrated in your columns, and is now finding considerable favor among the street railway people. The great improvement in this truck is in suspending the motor from overhead, it thus being absolutely free to move in accordance with the relative motion of the truck, whether one or two motors are used. The truck is also fitted up with the Peckham interchangeable elastic motor wheels and fibrous steel motor axles.

The Excelsior Electric Company, 115 Broadway, informe that they are making a fine exhibit of their motors at the St. Louis Exhibition, under the care of Mr. Randolph, of their Chicago office. The exhibit has been fitted up in a very handsome style, and the apparatus shown illustrates in an excellent manner the good work done by the company. I have no doubt that your Western correspondent will refer to this matter in his St. Louis notes. The company have just received a communication from Mr. A. J. Anderson, a hardware merchant of Fort Worth, Tex., that he has put one of their 1 h. p. motors in the First Baptist Church of that city, where it is pumping air for a large pipe organ made by Jardine & Son, of this city. The belt runs 40 revolutions per minute at the crank shaft. There is a series of levers from the bellows to the governor switch on the motor, so that as the bellows reach their upper limit the motor field is gradually cut out, and when the bellows become full of air the motor runs slow, and thus the work is kept up automatically with great success and perfection.

Mr. G. W. Walker has been experimenting for some time with his new meter for incandescent and arc circuits, and has brought out one which has been put on exhibition at the offices of the Julien Electric Company, 120 Broadway, where he will be pleased to show it at any time to any one interested. Your readers will remember that this ingenious meter was recently illustrated in the columns of THE ELECTRICAL WORLD. The one seen by your representative is somewhat like an ordinary gas meter. It incloses a mechanical movement carrying a slip of sensitive paper which passes before minute openings in a metal partition before which burns an electric lamp at about one-quarter its normal light. Between the lamp and the window, or perforations in the metal, is a needle held in a magnetic field, and as the current varies the needle will raise or lower, always stopping before one of the perforations, and recording its position upon the sensitive paper. One record taken, which I have seen, shows variations of from 5 to 12 amperes, and these variations for 3 hours check correctly with the comparisons from a Carpentier ammeter.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Sept. 21, 1889.

The Bell Telephone Company has declared a dividend of $3 per share, payable Oct. 15, 1889.

In Town this Week.—Mr. Osborn P. Loomis, Mr. Willard L. Candee, Mr. James Goldmark and Mr. George W. Euker.

Springfield, Mass.—A large Westinghouse alternating plant is being installed in this city by the Marr Construction Company, of Boston.

Andover, Mass.—This city now enjoys the service of electric light, and the citizens ushered in the new illumination by turning out in a body to see it.

Ashland, N. H.—A 500 light alternating plant has just been installed by the Marr Construction Company. Water power is used and is giving great satisfaction.

Bentley-Knight Company.—It is rumored that the Bentley Knight Company is negotiating for the sale of its patents to the Thomson-Houston Electric Company.

O'Danielsville, Conn.—The Killingly Electric Light and Power Company, of this city, have a contract with the Wright Electrical Engineering Company, of Boston, to do the necessary construction work for furnishing 75 arc lights.

The Cambridge Electric Railway will, after November 1st, secure its power from the Allston power station, the Cambridge Electric Light Company having decided to cease furnishing the power, as it was not a profitable business for them.

Dexter, Me.—The Dexter Electric Light and Power Company will move their central incandescent station two and one-half miles from Dexter, and use water power. They will install a Brush 600-light alternator, and expect to have a circuit of about ten miles.

Mr. L. H. Rogers, the energetic agent for the Brush Electric Company, secured last week the contract for putting in an alternating system at Dexter, Me. This is the first Brush alternator sold in the State of Maine, but Mr. Rogers gives his solemn promise that it will not be the last.

Mr. Fred. P. Barnes, formerly representing the Loomis Electric Manufacturing Company, has been appointed general district agent of the Westinghouse Electric Company, with headquarters at 620 Atlantic avenue, Boston. Mr. Barnes has long been identified with electric enterprise in the East, and will form a valuable acquisition to the Westinghouse Company,

Providence, R. I.—The Street Horse Car Railway Company of this city had intended making experimental trial of several electric cars operated by storage batteries. They depended on the electric light company to furnish the current with which to charge the batteries, but at the last moment found that this could not be done. A special dynamo will be installed for the purpose.

Mr. Geo. W. Euker, of 198 Broadway, New York, was a caller at this office this week. Mr. Euker has recently been appointed agent for New York, New Jersey and Pennsylvania for the Standard Electric Company, of Vermont, and is already meeting with good success, having recently sold four 500-light dynamos. Besides this agency Mr. Euker has a general electrical construction business.

The Marr Construction Company are installing a 250-light Westinghouse plant at Hartford, Vt. They have just completed large additions to the plants of the Westerly Gas Company, having installed a 750-light alternator, with 300 street lights. At Marlborough, Mass., they have nearly completed a 600 direct-current Westinghouse plant, and are building a model plant at Bridgewater, Mass., for arc and alternating lights.

The Wilmot & Hobbs Manufacturing Company, of Bridgeport, Conn., continue to do a large business in their numerous specialties in cold rolled steel, and brass and copper. They make large quantities of steel bells for electric purposes, and can stamp out steel, brass or copper in any desired shape. Brass, copper and steel tubing is also made a specialty of, and any desired size and shape can readily be procured.

The Wheelock Engine Company, Worcester, Mass., have just shipped a 350 h. p. engine to St. Louis, to furnish power for the Short system of electric railway, now being used in that city. So great has been the demand for this engine that the Wheelock Engine Company have been forced to build a new and much larger factory. The engine is of the slow-speed type, and is built in compound and triple expansion type for high duty. Its extreme simplicity recommends it to all requiring a steady and constant power, and it is meeting with favor among engineers for large electric light stations.

Chelsea, Mass.—The Chelsea Board of Aldermen held a public meeting this week to consider the question of electric lighting. The Chelsea Gas Company are sixty days behind their contract time for furnishing the electric light, and a resolution was offered to cancel the remainder of the contract, and that the Street Lighting Committee should take into consideration and report on the probable cost to the city of putting in an electric light plant of its own. The resolution passed its first reading. The Chelsea Gas Company have as yet only furnished about two-thirds of the required number of lights contracted for.

The New England Electric Supply Company, of Bridgeport, Conn., are now ready to supply the Orford patent rosette pendant with porcelain base and double cut-out. This pendant, as is well known, is designed to take the place of silk cord, and Mr. Orford is to be congratulated upon being the first to take a step in the right direction. Silk cord is very well in its place, but now that electric lighting has been thoroughly established, some more substantial means of suspending incandescent lamps is required. These pendants are extremely neat, flexible and durable, and meet all the requirements of insurance inspectors. They will eventually supersede the cheaper and less substantial silk cord suspension.

Pettingell, Andrews & Co. have now got comfortably installed in their new and commodious quarters in the Estes Press Building, 196 Summer street, Boston, where they will be better able to cope with their rapidly increasing business. The store has an ample floor space, and is well lit, though two of the windows are almost obscured with the familiar Okonite trade mark. Electric

lights are now being put in throughout the building, and K. W. cut-outs may now be seen in operation as well as by sample. The two huge models of the cut-out continue to guard the portals of the office door as before. The store, when thoroughly arranged, promises to be a very comfortable one, and Messrs. Pettingell, Andrews & Co. are to be congratulated on the change.

The Armington & Sims Engine Company, Providence, R. I., are rapidly pushing toward completion another large addition to their already extensive works, which will give them an average productive capacity of 150 h. p. per day, possibly the largest output of any similar concern in this country. Their order for machinery of sizes larger than ever before used by them has been placed with Pond Machine Tool Company, Plainfield, N. J., Manning, Maxwell & Moore, No. 111 Liberty street, New York, and Nicholson & Waterman, Providence, R. I. Overhead railways, travelers and special tools required will be made from their own designs and patterns, similar to those now in use, which has enabled the Armington & Sims Engine Company to reduce the cost of production 18 per cent. in t he past five years. Steel rails and turntables are furnished by Wm. Wharton, Jr., & Co., Philadelphia. The prosperity of Messrs. Armington & Sims, pioneers in the building of a successful electric light engine which can now be found in almost all countries of the world, verifies in a measure your early prophecy of the magnificent future for electricity as a commercial success. No better or more well deserved compliment could have been bestowed on Messrs. Armington & Sims than the description and honorable mention of their engine given by the "Encyclopædia Brittanica." A. C. S.

WESTERN NOTES.

Branch Office of The Electrical World,
39 Mallers Building, Chicago, Sept. 21, 1889.

The Kansas City North East Electric Railway Company bonds, amounting to $250,000, were sold on the 4th inst. to the Jarvis-Conklin Investment Company, of Kansas City. The road will be equipped with the Thomson-Houston electric motor, the same as now in use on the Armourdale line. Nearly every part of the construction and equipment of the road is now under contract to be completed by January 1, 1890. The new road will take the place of the Independence avenue horse car line, running over the old track to Independence and Highland avenues. It will then be extended on Phelps, Maple, Lexington and St. John avenues to a point a half mile east of the city limits. The road will have three and one-half miles of double track. The officers of the Northeast street railway company are W. H. Winants, president; E. A. Phillips, vice-president and manager; J. H. North, treasurer, and W. C. Scarritt, secretary. Every dollar of both stock and bonds is owned in Kansas City.

Affairs in Milwaukee.—The Milwaukee *Sentinel* of Sept. 6 contains a two-column article relating to the bitter fight now being carried on in the city council over the granting of an electric light franchise to the Edison Electric Illuminating Company, organized a short time since by some twenty prominent citizens of Milwaukee, who subscribed $100,000, while the parent Edison Company subscribed $250,000. On the following day the same paper stated that the Thomson-Houston Electric Company, of Chicago, had secured a controlling interest in the Badger Illuminating Company, and that an order for 350 arc lights had been sent into the factory, increasing the capacity of the local plant to a total of 750 arc lights. It was further stated that the Thomson-Houston Electric Company would also control the proposed Hinsey Electric Railway, owned by John A. Hinsey, the president of the Milwaukee council. The following Monday evening the Common Council passed by a vote of 34 to 1 the ordinance granting the Hinsey Company the right to use the overhead wire electric system on their new street railway. The *Sentinel* further says: Washington Becker, president of the West Side Street Railway Company, returned to-day from the East, where he had been investigating the electric street railways in Boston, Lynn and Washington. He says they are working so satisfactorily that he will ask the council for a franchise to transform his horse railway into an electric railroad. At this evening's council meeting the Cream City and Milwaukee city lines asked for electric franchises, so that eventually the entire street railway service of Milwaukee will be an electric system.

Charles T. Yerkes, President of the North and West Side Street Railway companies, with Mrs. Yerkes and her sister, Miss Annie Moore, of Philadelphia, has returned from an extended trip through England, France and Switzerland, where Mr. Yerkes has been inspecting the various traction systems employed in the different cities, and searching for improvements applicable to the conditions under which a line must be operated in this city, where overhead wires are not permitted. In conversation, Mr. Yerkes intimated that no immediate changes in the method of operating the lines will follow, but in time the advisability of employing storage cells on some of the side lines, Sedgwick and Larrabee streets, for instance, may be taken under consideration. Reference was made to the operation of the Fourth avenue line in New York, employing the Julien system, and to the suburban line in London, installed by Immisch. Mr. Yerkes' connection with the street railway lines came about in 1886, while a member of the Chicago Board of Trade, through accidentally learning that the controlling interest in the North Side lines could be purchased at a fair price from Norman S. Ream and V. C. Turner. A thorough inspection convinced Mr. Yerkes that the purchase would prove a profitable transaction if some system of rapid transit could be introduced, and on securing control of the entire line he proceeded to investigate the merits of the different electrical railway systems, in the hope that one could be found not using overhead wires that would have sufficient merit to warrant its adoption. As the city refused to allow the installation of an overhead line, and as the system of propulsion by storage batteries had not then given the gratifying commercial results since attained, Mr. Yerkes was compelled to adopt the cable. Yet Mr. Yerkes stands ready to adopt any practical improvement over his present system, or to incorporate therewith every suitable device that will benefit the public, and thus indirectly increase the patronage of his lines, which has already increased many fold. The total mileage of all the lines, including the West Side, is 184 miles, with a total rolling stock of 1,413 cars. One of the most interesting of his experiences abroad was the delightful trip taken in the Immisch electric launch on the Thames, the current for the motive power being supplied from 200 accumulators operating two motor of 7½ h. p. each, driving twin three-bladed propellers. The novelty of the situation, the entire absence of the smoke, heat, vibration and noise, that are ever present where steam power is employed, made the ride one of the memorable features of the tour abroad. The launch in question was 65 feet in length, with 10-foot beam, would carry nearly 100 passengers and contained handsomely-fitted cabins finished in mahogany, lavatories, etc. It has been illustrated in The Electrical World. It stopped at various stations along the river, and at nightfall would tie up at the dock, to which point an electric circuit was run, and by means of flexible cables the cells were recharged for the following day's trip. While this system of propulsion was somewhat more costly than the ordinary methods employed, yet so far as Mr. Yerkes could learn, it gave perfect satisfaction, and was so attractive to tourists that an excellent passenger traffic was secured. F. de L.

Louisville, Ky., Sept. 18, 1889.

The Pioneer Worsted Mills, of Louisville, will put in a plant of 200 incandescent lamps at their mill on Logan street.

The Galt House.—They are now rewiring the Galt House here for 20 arc lights. The engine and dynamo are already in position, and in a few days more the Galt House will manufacture its own "lightning."

The Thomson-Houston Electric Railway here has proved itself to be a great success, if continually crowded cars are considered proof, and I think that is the proof most looked for by the street railway men.

The Fort Wayne Jenney people are installing a very complete plant at Evansville for arc and incandescent lamps, and will be ready to serve the public in a few days. They are now wiring several buildings and are full of orders.

Mr. J. W. Rigby, electrican for the Marr Construction Company, of Pittsburgh, Pa., has just completed one of the finest incandescent installations in the South-west at the Grand Opera House in Evansville, Ind. Although there are no novel features brought out, he arrangement of the lamps is worthy of notice, and shows how admirable is the adaptation of the incandescent lamp to the most advanced and exacting ideas of interior decoration. One good feature is, that although the plant consists of 1,120 16 c. p. lamps, and many of them very high (one row of fifty-six 16 c. p. being beautifully studded in rosettes around the proscenium arch, while another row of forty six 16 c. p. is studded in front of the sounding board), they can be replaced at a moment's notice, and that without the use of a ladder.

The specifications called for the very highest grade of work in the wiring. The wire used is known as W. A. C., and is manufactured by the Standard Underground Cable Company, of Pittsburgh, Pa. The circuits are so run that no one part of the house will be without light, from the blowing of a fuse, or from any other cause. All this work has been done under the careful personal direction of Mr. Rigby. The alternating current is supplied by the Evansville Gas and Electric Light Company, and on the primary wire is 1,000 volts; 28 converters of forty 16 c. p. lamps capacity each are located in the basement. The current from them is 50 volts for the lamps. The regulation of the lights is done on the stage, where also all the other lamps are controlled. Every endeavor has been made to make this plant as complete and perfect as possible, and it certainly reflects credit on the electric skill of Mr. Rigby and his assistants. W. J. F.

ENGLISH NOTES.

From Our Own Correspondent.]

London, Sept. 4, 1889.

The Postmaster-General's Report.—The report of the Postmaster-General on the past year's working of the telegraph is on the whole very satisfactory. The number of telegrams sent during the year has increased by 8.5 per cent, and the gross total is now 58 millions, against 10 millions in 1870, the year in which the telegraphs were taken over by government. It is now about four and a half years since the introduction of the sixpenny rate, and in that time the annual number of telegrams has nearly doubled. The accounts of the telegraph department also show an improvement, and a net revenue of £87,275 is now being earned, as against a net loss of £84,000 in 1887. This profit, however, it is perhaps needless to say, does not take into account the annual accumulated interest on the original purchase money. The year ending March 31 was, I may mention, chiefly notable for the purchase by government of the Continental cables. On Monday last the sending of telegraphic money-orders was commenced in an experimental way, and if the experiment proves a success the Postmaster-General will probably extend the system to the whole of the United Kingdom.

Underground Main Laying in the Metropolis.—The work of laying underground mains has at last begun in earnest. Along the Strand, Messrs. Gatti, the well-known restaurateurs, who have a small central station of their own, and who apparently have made some private arrangement with the Vestry, are laying Callender-Webber conduits. These conduits are of the Dorsett type, and consist of solid asphalt troughing, pierced with 2-inch ducts, and joined together by running molten asphalt round the seam. The conduits are protected at the sides and on the top by thin iron plating. The Metropolitan Company are also at work on the same thoroughfare, laying mains in connection with their Westinghouse station in Sardinia street, which is expected to commence the supply of current in about six weeks. The method of laying mains employed by this company is simplicity itself; 6-inch iron pipes are run under the roadway, and the mains, positives and negatives together, are drawn in from the various draw-boxes. The mains of both companies are obliged, owing to the maze of pipes and tubes, to take several bends and turns, and it is to be hoped that these will not give rise to difficulty when the time comes for drawing in the cables. Further westward in Piccadilly, the St. James & Pall Mall Company are working hard. This company have adopted the three-wire system, and their mains are of an unusual description. The conductors are of bare copper strips, supported at intervals on china insulators, the whole being enclosed in iron conduits. The copper strips are 2 inches broad and about 1-32 inch thick; the side mains consisting of 16 of these strips, and the neutral main of 8 strips. It will thus be seen that the metropolitan companies have fairly settled down to work.

THE TELEGRAPH.

Mr. S. Oi, of the Japanese government telegraphs, is now in this country investigating telegraph systems and details.

The Delany Sychronous-Multiplex.—The British Government has the right of the use of the Delany system of telegraphy, and uses the system in its postal telegraph service. The royalties from this are all deposited with Baring Bros. & Co. The firm of Jones & Goodwin were interested in keeping the patent alive. The royalties are deposited in keeping to the joint account of the Standard Electric Manufacturing Company and Wendell Goodwin and Frank T. Jones. Justice Van Brunt gave judgment in this city on Sept. 12 for $23,347 in favor of Jones & Goodwin, and directing that Baring Bros. & Co. pay them that amount before paying any other royalties.

THE TELEPHONE.

Alabama.—A telephone line from Huntsville to Guntersville is to be built by G. Lippincott, C. W. Thornburg and others.

The Claims of Croes.—A special dispatch from Paris, of Sept. 20, says: A pamphlet has been published here which assails Mr. Thomas A. Edison's right to be regarded as the original inventor of the phonograph, and to enjoy the emoluments of his patents in this country. The real object of it, however, is not so serious as this. It is put forward with a view to obtaining assistance from the government for the widow and family of a French man named Charles Croes, a poet and scientist, on the ground that he anticipated one of Edison's most important inventions. The *brochure* asserts that Mr. Croes sent a sealed paper to the Academy of Sciences, in which he described an apparatus which he had invented, similar to the phonograph, in April, 1867. His friends claim that his invention antedated Edison's patent, and that therefore France ought to recognize the right of his family to consideration.

Mechanical Telephony.—Mr. Geo. F. Shaver, of the Shaver telephone, has received from the Buffalo International Fair, the following remarkable indorsement of his apparatus: "The Shaver mechanical telephone exchange bought of you has been in constant use since the opening of the fair (10 days), and has given good service, although rain and wind storms have prevailed part of the time. We have ten stations, and switch direct one station with another, the time required for making a connection being about five seconds; the longest line is about one half mile, and the longest circuit when connected through the Central office is about seven-eighths of a mile. We can recommend it as being fully equal to the electric telephone in articulation, besides working much louder." This is signed by C. J. Hamlin, president; C. W. Robinson, secretary and general manager; J. F. Hause, assistant secretary; H. B. Stimson, treasurer; B. F. Taylor, general superintendent. Since the fair Mr. Shaver has received a number of large orders from some of the biggest and best concerns in Buffalo. We have ourselves seen several of them.

THE ELECTRIC LIGHT.

Newark, Del., will buy a plant.

Oshkosh, Wis., proposes to operate a plant of its own.

The Athens, Ga., Gas Company are to supply the city with 30 arcs.

McMinnville, Ore., has made a contract for an electric light plant, it is reported.

Berkeley, Cal.—The Alameda Water Company proposes to operate an incandescent plant.

Red Oak, Ia., has declared for electric lighting, but against a plant to be run by the municipality.

Savannah, Ga.—The Mutual Gas Light Company is to put in a large electric lighting and power plant.

Columbus, Ind., talks of buying an electric light plant. Mr W. Shea is city clerk and can give details.

The Port Hope, Ont., Electric Light and Power Company has been formed with a capital stock of $40,000.

Harrisonburg, Va.—The Harrisonburg Ice Manufacturing Company propose to put in an electric light plant.

Lincoln, Neb.—Baltimore capital has been invested in the gas works and now seeks to control the electric light plant.

Barrie, Ont.—The Barrie Electric Light Company is to run a Brush alternating plant by water power, four and a half miles distant.

Sault Ste. Marie.—The Sault Ste. Marie Water Power and Electric Company has bought a water power privilege embracing 38 acres, for $29,000.

The Sheboygan, Wis., Electric Light Company has been formed by A. F. Leberman, W. D. Crocker and others, with a capital stock of $25,000.

Argentine Republic.—The Government, in view of numerous explosions of oil lamps, has ordered that all railway cars shall be fitted up with electric light.

Blair, Neb.—The Blair Electric Light and Power Company has been incorporated by E. W. Kenny, S. P. Howe, F. M. Cassett and others, with a capital stock of $300,000.

Duluth, Minn.—The Duluth Electric Company has secured a three years' contract for 2,000 c. p. lights, at 35 cents per night, and at 33⅓ cents for all lights above the first hundred.

Southern Notes.—F. A. Wyman and others, of Bridgewater, Va., will buy a $15,000 electric light outfit. J. E. Beck, A. P. Waddell and others, of Dresden, Tenn., will put in an electric light and power plant at Union City. The Louisiana Electric Light and Power Company, of New Orleans, propose to increase their capital stock to $500,000. S. H. Turner and others, at Hopkinsville, Ky., will put in an electric light plant and build an electric road.

The Phœnix Electric Light & Power Company.—The Phœnix Electric Light & Power Company, for supplying electricity for light, heat and power purposes in the cities of New York, Brooklyn and other places in the United States, has filed articles of incorporation in this State. The capital named is $500,000. The incorporators are George P. Valentine, C. W. Platt, E. L. Johnson and James B. Lathrop, of New York, and James W. Purdy, Jr., of Brooklyn.

APPLICATIONS OF POWER.

Green Bay, Wis., is to have a Thomson-Houston electric road.

Newark, O.—The Granville & Newark Electric road will adopt the Sprague system.

Peabody, Mass.—A franchise has been granted to the Essex Electric Railway Company.

Sherman, Tex.—The College Park electric road is to be built by Griggsby Bros., of Dallas.

Americus, Ga.—The Americus Electric Street Railway Company are now building their road.

Owensboro, Ky.—The Owensboro Street Railway Company propose to adopt electricity at once.

Ottumwa, Ia.—The Ottumwa Street Railway Company has been granted a broad electric franchise.

Virginia.—Mr. M. W. Mason, of Norfolk, writes to the *Manufacturers' Record* as follows: "We will put in electric street railway plant in Berkley as soon as franchise can be perfected, say

about 40 days. Will want engine, boiler and electrical equipment, and steel rail (T), 30 pounds to the yard, etc."

Nashville, Tenn.—Dr. W. Morrow has bought a controlling interest in the Edgefield & Nashville Street Railroad, to operate electrically.

PERSONALS.

Mr. J. T. Evans, the president of the Ottawa, Ill., Electric Railway Company, has been given a banquet by his appreciative fellow citizens.

Mr. J. Crawford has renewed his connection with the Sprague Company, and will be engaged on important work in the street railway department.

Mr. W. C. Richards has in progress, we are informed, another edition of his "Electron," making it a history of electricity down to the present time.

Mr. R. McKie, one of the electricians of the Fort Wayne Electric Company, disappeared from Fort Wayne with another man's wife, week before last. He was to have married a young lady of Cooperstown, N. Y.

Mr. W. H. Preece has been discussing the subject of death by electricity, before the British Association, and has expressed, cable reports say, a very decided opinion as to the uncertainty of killing by means of electrical apparatus. He found many of the newspaper reports on the subject to be exaggerated and untrue.

Mr. D. W. McAnneeny is well known in electrical circles in New York and Brooklyn as a singer of unusual excellence, and one always ready to lend a helping voice for sweet charity. He is to be given a grand testimonial concert at Chickering Hall, this city, on Nov. 28, under the management of leading telegraphic people, and may expect a rousing house.

Mr. William Whitney Munroe, formerly Western Manager for the Baxter Electric Motor Company, at Chicago, has been appointed Manager of the Stationary Motor Department of the Sprague Electric Railway and Motor Company, with headquarters at 16 and 18 Broad street, New York. Mr. Munroe will have charge of the stationary motor business of the Sprague Company in the United States.

BUSINESS NOTICES.

The Abendroth & Root Manufacturing Company, of New York, have just booked an order for eight of their sectional safety boilers, to be shipped to Yokahama, Japan. This concern has been running full of business for several months past, and is erecting at Greenpoint an additional factory, 200 feet long by 175 feet wide, to meet future demands.

Patterson, Gottfried & Hunter (Limited), 146-148 Centre street, carry a complete stock of Brush copper, celluvert fibre oiled paper, hard rubber, rod and sheet brass, brass, copper and iron wire, self-hardening tool steel, set and cap screws, machine bolts, machine and wood screws, taps and dies, files and twist drills, blowers and forges, machinery, tools and hardware, gear wheels, wood pulleys, shafting hangers and belting. General factory supplies.

The Baker Oil Filter.—Among recents shipments of Common-Sense oil filters are the following: One to N. W. Electrical Construction and Supply Company, St. Paul, Minn.; one to Smith & Duncan, Helena, Mont., for Hotel Broadwater; one to F. W. Brickey, Prairie Du Rocher, Ill., flour mill; one to William C. Leistikow, Grafton, Dak., flour mill; one to Citizens' Electric Light Company, Helena, Mont.; and two to Wm. B. Bushnell, Tacoma, Wash., for use with refrigerator machines. The filter is handled by W. E. Crane, 421 Thirteenth avenue, southeast, Minneapolis.

The Wheelock Engine Company.—This company, which manufactures the well-known Wheelock engine, has found its business increasing so rapidly that it has been necessary to build a new and much more commodious factory. The Wheelock Company have just shipped a 350 h. p. engine to St. Louis for use in furnishing power for the Short system of electric railway now being put in, in that city. The Wheelock engine is of the slow speed type, and is built compound and triple expansion for high duty, and is meeting with great favor among engineers for large electric light stations. Its extreme simplicity recommends it to all requiring a steady, constant and reliable power.

The Stillwell & Bierce Manufacturing Company, Dayton Ohio, report that since the beginning of this year they have placed more 54-inch and 55-inch wheels than were placed in any one year before by all the builders, including themselves. They further report an increase in the total business transacted thus far this year of nearly forty per cent. in excess of the amount for the corresponding period of last year, and claim that ninety per cent. of this increase has been received from electrical companies. It is worthy of note that this company recently shipped to a station in Central Africa a set of horizontal Victor turbines having two pair of twelve-inch wheels on horizontal shaft.

MISCELLANEOUS NOTES.

Edinburgh, Scotland, is to have an electrical exhibition.

Washington, D. C.—Superintendent Miles, of the District Telegraph & Telephone service, recommends in his annual report the placing of the district wires under ground, to be completed at an estimated cost of $250,000. He also recommends the erection of 100 additional fire-alarm boxes.

The New York Belting and Packing Company, 15 Park Row, this city, have distributed among their friends and customers a very neat little paper cutter and envelope-opener for office use. It is wholly of metal and is very ingeniously made. The broad handle bears the name of the company on one side, and the obverse mentions a few of their products.

The Gibson Storage Battery.—Mr. Henry S. Iselin, President of the Gibson Electric Company, writes us as follows: "We notice in your issue of Sept. 21, following an extract from the New York *Times*, mentioning the running of the car on Broadway, that 'the car in question is that of the Electric Car Company of America.' This is partially true and partially untrue. The car and motor were furnished to this company by the Electric Car Company, and fitted up by ourselves with the Gibson battery."

The Eugene F. Phillips Electrical Works, Limited, was organized at Montreal, Canada, on Sept. 10, with a capital of $60,000. The officers are Eugene F. Phillips, president; E. A. Smith, vice-president; J. Cooper, of Montreal, secretary and treasurer; Frank S. Mead, general manager. The company have secured a new factory, one of the best in Montreal, 100 feet long by 45 feet wide, and 4 stories high. It has been thoroughly equipped with machinery made and sent from this country. All the apparatus is set up, running, and ready to turn out work. Mr. Mead, the manager, was Mr. Sawyer's assistant at Providence for ten years, and being a good electrican to boot, he may be expected to turn out a very fine product. The reputation of the American Electrical Works is world-wide, and so high that it really could not be higher, and it is the determination of President Phillips to secure an equal standing for the Canadian enterprise in all the various makes of insulated wire, cable and other specialties. Mr. Phillips has the heartiest good wishes of innumerable hosts of American friends; and his efforts will undoubtedly do much to help on the electrical development now taking place so encouragingly in the Dominion.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

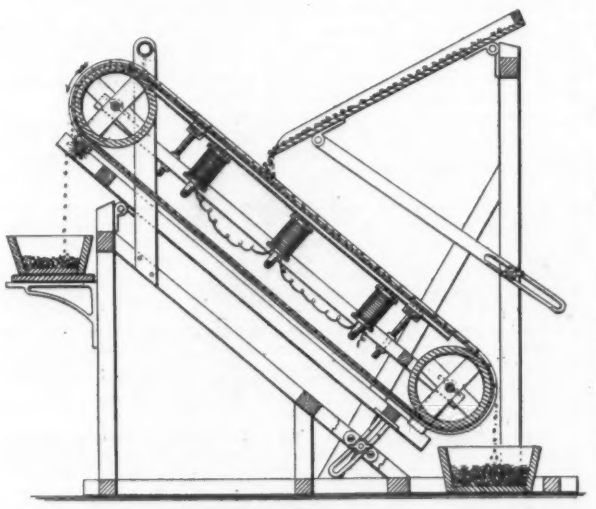
PATENTS ISSUED SEPT. 10, 1889.

410,586. Electric Lighting of Railway Cars; Theodore M. Foote, of Boston, Mass. Application filed April 25, 1888. In a railway car having the usual swiveling trucks and a combination of car wheels with an electric lighting system for said car, the combination consisting of a pulley upon an axle of the car truck a belt led from said pulley toward and near to the centre of oscillation between the car and truck, guide pulleys attached to the body of the car near said centre of oscillation and an automatic reversing clutch.

410,592. Armature; Josef R. Johnson, of Yonkers, N. Y. Application filed March 27, 1889. The conductors of the armature are composed of copper bars.

410,637. Insulator; William M. Davis, of Plymouth, Mass. Application filed April 25, 1889. A bridle for insulators, made of wire in two strands, the strands being oppositely bent intermediate their ends to form a loop, and the shield-plate provided with opposite hook ends to engage the opposite portions of the loop.

410,652. Magnetic Body-Wear; George Augustus Scott, of New York, N. Y. Application filed May 15, 1889. The combi-



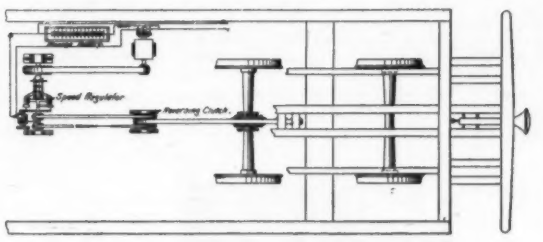
410,877.—MAGNETIC SEPARATOR.

nation of a chest vesture adapted to human environment, provided with opening band sockets, and a series of magnetized metal bands inserted therein.

410,656. Method of Determining the Shape of Pole-Pieces for Dynamos; John Grice Statter, of London, County of Middlesex, England. Application filed March 26, 1889. Patented in England, Feb. 23, 1887; in Belgium, Feb. 2, 1888; in France, April 13, 1888, and in Spain, May 14, 1888. The method of determining the shape of the pole-pieces of dynamo-electric machines or motors to prevent sparking when the brushes are shifted, which consists in running said dynamo or motor with a constant current and resistance of a variable load, respectively, changing the position of the brushes around the commutator, measuring the difference of potential between the adjacent coils around the commutator to correspond with each position of the brushes, plotting the curves of said differences of potential setting out ordinates corresponding with the various positions of the brushes and noting the points where the said ordinates cut their corresponding curves, joining the points so located by a line and constructing the pole pieces to correspond with the position and shape of this line and substantially in proportion to the area inclosed by said line, then running the dynamo under normal condition again and shifting the brushes as before, measuring the differences of potential between the adjacent coils around the armature as before, and shaping the pole pieces until the curves representing the difference of potential in adjacent coils cut the zero line of said curves at points corresponding to the location of said brushes.

410,663. Regulator for Dynamo Electric Machines; Julien M. Bradford, of Portland, Me. Application filed Dec. 27, 1887. The combination with a dynamo electric machine, of two stop motion regulating devices, electric circuits for controlling said regulating devices, a line current indicator and two regulating wheels for controlling the dynamo, and two eccentrics arranged on the driving shaft for obtaining accumulative and differential action.

410,670. Brush Holder for Dynamo Electric Machines; Charles D. Jenney, of Indianapolis, Ind., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Aug. 2, 1888. The combination in a brush holder for dynamo electric machines, of a brush holder frame loosely mounted upon its shaft, an arm fixedly mounted on said shaft, a rod connecting



410,586.—ELECTRIC LIGHTING OF RAILWAY CARS.

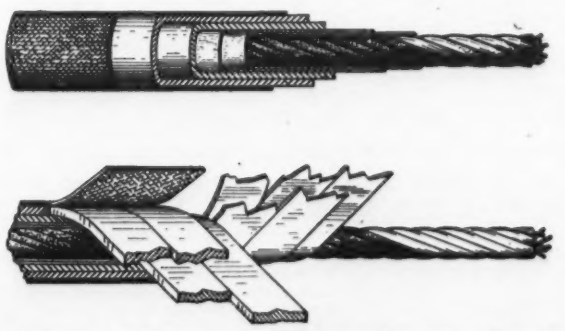
said brush holder frame and said arm, an adjustable spring whereby said brush holder frame is forced forward, and a cam, whereby the brush holder frame may be retracted.

410,680. Secondary Battery; Jean Theodore Van Gestel, of New York, N. Y. Application filed Dec. 12, 1888. An electrode for use in a secondary or storage battery, made of a single piece of lead or analogous material, having angular retaining shelves on its opposite faces, said shelves being located in a common plane, and having turned up lips or ledges for holding the active material in place.

410,683. Burglar Alarm; Edwin M. Carhart, of Providence, R. I. Application filed Dec. 26, 1888. A short circuit spring for burglar alarms consisting of an electrically connected shell or casing, a spring actuated contact pin provided with a cone-shaped head mounted within the shell, and an electrically connected plate provided with an enlarged central opening through which the outer end of said pin slightly extends thereby when in its normal position, forming an annular space around the pin.

410,689. Electric Light Fixture; John C. Hollings, of Boston, Mass. Application filed March 26, 1889. Consists essentsentially in the combination, with the standard or body of a fixture of a longitudinally movable or telescopic covering.

410,786. Electric Registering Deep-Sea Sounder; Alfred J. Cooper, and Eustace E. Wigzell, of London, England. Application filed Oct. 24, 1888. In a registering deep sea sounder,



410,953.—AIR-TIGHT COVERING FOR ELECTRIC CABLES.

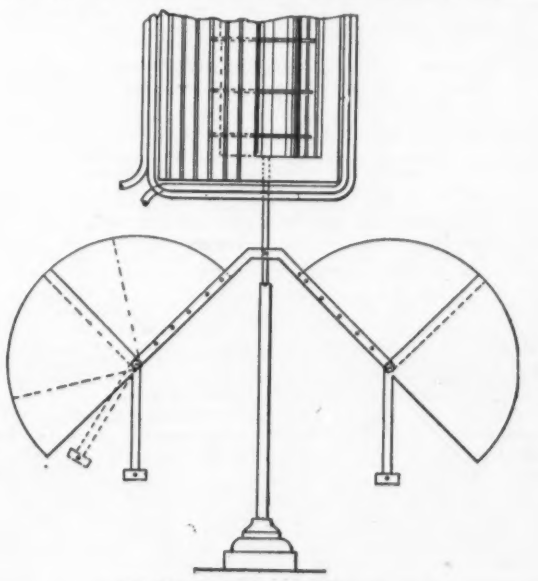
a submerged portion having a spring pressed piston in communication with the sea and moved by hydrostatic pressure, and an electrical make-and-break device contained in a special sealed or water-tight chamber operated by the upward movement of the serrated rod of said piston against an elastically supported sliding bead opposite to said electrical contacts, the said bead falling out of position on return stroke in combination with an upper portion provided with electrical registering mechanism fitted with an electro-magnet making a registering pulsation for every make and break in the circuit from the submerged portion of the sounder, and with electrical connnectors connecting said make-and-brake device with the said registering mechanism.

410,791. Acoustic Telephone; Larkin V. Elliott, of Moorestown, Ind. Application filed Feb. 5, 1889. The diaphragm for acoustic telephones, consisting of parallel sheets of rawhide, which are held out of contact by an interposed filling or layer of soft fibrous material.

410,870. Electric Meter; Marmaduke M. M. Slattery, of Fort Wayne, Ind. Application filed May 17, 1889. In an electric motor meter a retarding device consisting of a fan revolving against atmospheric pressure, and having one portion fixed rigidly to the motor-shaft, with a movable portion or portions adapted to slide over the fixed portion by the action of centrifugal force at high velocity, and so reduce the area exposed to atmospheric pressure.

410,876. Process of Separating Magnetic from Non-Magnetic Particles; Gurdon Conkling, of Glens Falls, N. Y. Application filed Jan. 26, 1889. The process of separating magnetic from non-magnetic particles, which consists in exposing a running stream of liquid containing the substances to be separated to the action of the magnet, lifting the magnetic particles carried by said stream up from and out of contact with the stream, and finally conducting the particles which have followed the attraction of the magnet in a suitable receptacle.

410,877. Magnetic Separator; Gurdon Conkling, of Glens Falls, Assignor to the Conkling Ore Dephosphorizing Company, of New York, N. Y. Application filed Jan. 31, 1889. The combina-



410,870.—ELECTRIC METER.

tion, in a magnetic separator, of an endless belt, a magnet situated within said belt close to its upper strand and extending in the direction of the belt up to the highest point of said upper strand, or nearly so, a frame constructed to retain said belt and magnet in an inclined position, and a trough situated above the belt and the magnet.

410,896. Commutator Brush for Dynamo Electric Machines or Motors; Rudolph Hoffman, of Zurich, Assignor to the Maschinenfabrik Oerlikon, of Near Zurich, Switzerland. Application filed June 30, 1888. The invention includes only the brush holder, which is a compound lever permitting of easy adjustment of the brushes.

410,953. Air-Tight Covering for Electric Cables; David Brooks, Jr., of Philadelphia, Pa., Assignor to the Electric Cable Construction and Maintenance Company, of same place. Application filed Dec. 29, 1888. An insulated bunch of wires having a covering composed of a layer of tin-foil, an outer covering of rubber, with an exterior wrapping of fibrous material having a rubber coating.

(1) 410,964. (2) 410,965. (3) 410,966. Magneto-Electric Machines; Arden S. Fitch, of New York, N. Y. Applications filed (1) and (2) June 20, 1889. (3) Aug. 21, 1889. (1) and (2). The invention relates to magneto-electric machines which are especially adapted for developing a current of electricity for firing fuses in blasting operations and kindred uses; and consists in the combination with the device which operates the rotary armature of a magneto electric machine in which are two distinct and separate circuits, one including the armature, magnet coils and connection inside the machine, and the other comprising the working circuit, in which are the fuses outside of the machine, of a circuit controller common to both said circuits and adapted to have motion concurrent with the armature operating device, and to maintain the inside circuit closed and the outside circuit open, or broken during the movement of the operating device in one direction to rotate the armature, and to establish electrical connection between the inside and outside circuits at the conclusion of the

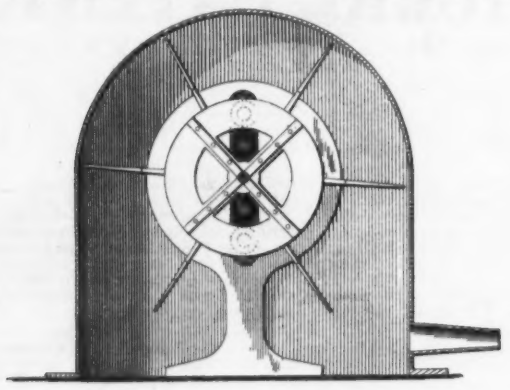
movement of said operating device, whereby during the development of electricity in the machine by the rotation of the armature the entire current is accumu ated in the magnet coils in the inside circuit, and no part thereof passes to the outside circuit, and at the conclusion of the movement of the operating device, when said armature has attained the maximum of its velocity in its rotation, the thus accumulated entire circuit is automatically and instantly transferred in its full volume and intensity to the outside of working circuit. (3) In a magneto-electro machine the combination, with the armature operating device adapted to swing or roate in its movement to oper te the armature for the generation of an electric current, of a bar seated in or upon said armature-operating device and adapted to slide or move longitudinally therein and transversely thereof.

(1) 410,987. Dynamo Electric Machine and Motor. (2) 410,988. Method of Operating Electric Motors; Francis Jarvis Patten, of New York, N. Y. Application filed (1) July 8, 1889; (2) July 24, 1889. The method of operating an electric motor connected in an alternating current circuit, which consists in giving a constant polarity to a continuously wound armature circuit by sending the opposite impulses of current successively to opposite sides of the armature winding, and in giving a constant polarity to the field magnet by a similar and simultaneous delivery of the same impulses to the field circuit.

U. S. PATENTS ISSUED SEPTEMBER 17, 1889.

(1) 411,016. (2) 411,017. (3) 411,018. (4) 411,019. (5) 411,020. (1) and (5) Manufacture of Carbon Filaments; (2) Carbonizing Flask; (3) and (4) Manufacture of Incandescent Lamps; (1) Thomas A. Edison, Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York, N. Y. (2), (3), (4), (5), Thomas Edison, of Menlo Park, N. J. Applications filed (1) Oct. 20, 1882; (2) April 17, 1883; (3) July 17, 1886; (4) July 29, 1886; (5) Feb. 11, 1889. (1) The method of ascertaining the character of the carbon filament intended for use in an incandescent electric lamp, consisting in immersing the filament in a non-oxygenated liquid inert under the condition described, and then raising the filament to a red heat by passing an electric current therethrough. (2) A carbonizing flask constructed of a material, such as plumbago or nickel, capable of withstanding a high temperature, and composed with a base with a raised edge, a cover resting on said base within the raised edge and leaving a space between the cover and edge, a luting—such as graphite—capable of withstanding a high temperature placed in said space, and a body of carbonized cotton placed in the joint between the parts of the flask. (3) The process of manufacturing incandescent lamps, consisting in externally heating the lamp globes during the process of exhaustion. (4) The method of removing moisture from the inclosing globe of an incandescent electric lamp, which consists in hermetically sealing said globe to a sealed chamber containing a material capable of absorbing or decomposing such moisture and then externally heating said globe. (5) The method of making carbon filaments for electric lamps, consisting in forming filaments from a plastic refractory material, baking said filaments, coating said filaments with carbon, and then removing the refractory material by a solvent.

411,030. Combined Electric Motor and Blower; Charles J. Hirliman, of Fort Lee, N. J. Application filed May 6, 1889. In this apparatus the armature of the motor is formed of a wooden wheel having attached to each side of it a number of soft iron strips constituting the armature or armatures proper. In



411,030. COMBINED ELECTRIC MOTOR AND BLOWER.

the periphery of the wooden wheel the fans or blades of the blower are placed. The field magnets of the motor are four in number, and they are located two each side of the armature. The whole structure is placed within the blower casing, and is thus protected from injury through external agents or causes.

411,042. Electric Meter; Harold Werner Kolle, of London, County of Surrey, England. Application filed July 30, 1888. Patented in England October 6, 1887. A meter for measuring ordinary alternating currents of electricity, consisting of an electrolytic cell, metallic electrodes suspended therein, a means for indicating the precipitation of metal from the said electrodes, and electric current connections from the said electrodes to a supply source of ordinary alternating currents of electricity.

411,058. Mechanical Telephone; Chas. M. Ralford, of Concord, N. H., Assignor to himself, Frank L. Blood, of Groton, and Freeman Emmons, of Wakefield, Mass. Application filed June 14, 1889. In a mechanical telephone, a transmitter, a button disposed in the diaphragm thereof and provided with an elongated shank, and a series of conducting wires secured within the transmitter and passing through the button shank.

411,088. Arc Lamp Frederick Richard Boardman, of London, County of Surrey, England, Assignor of one half to Bernat Carl Wilhelm Peterson and Mads Peter Hardt, of same place. Application filed Aug. 14, 1888. In an arc lamp, the combination of one or more solenoids, each having a core attached to a vertical rack bar, a marble block with an aperture therethrough, two electrodes in connection with said block, one of which is movable, a horizontal rack bar attached to said movable electrode, a pinion with which the rack bars engage, and the circuits and connections.

411,093. Instrument for Connecting Line Wire; William H. Coughlin, Worcester, Mass., assignor of one-half to Herbert H. Fairbanks, of same place. Application filed April 29, 1889. An instrument for the purpose specified, comprising a flexible conductor provided at each of its respective ends with a metal bar having a transverse notch or recess near its end for the reception of the line wire of an electric lighting circuit, and a spring or jaw adapted for pressing the wire into the notch and holding it in connection therewith.

411,120. Signaling Apparatus; William R. Cole, of Detroit, Mich. Application filed Jan. 4, 1889. In a signaling apparatus the combination of the two circuits and a battery therein, a metal case provided with a signal, an armature and magnets in said case, the metal frame having the thrown out portion attached to the inside of one wall of the case and insulated therefrom and provided with the projections, the needle attached to one of the projections and the spring attached at one end to the other projection, insulated therefrom and attached to the armature at the other end.

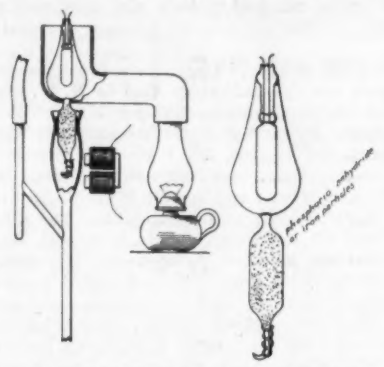
411,124. Receptacle for Secondary Batteries, Fred. W. Huestis, of Newton, Mass. Application filed March 5, 1889. As a new article of manufacture, a receptacle for secondary batteries, composed of balata as a base, combined with acid proof material, as asbestos, in suitable quantities.

411,133. Electric Polarized Annunciator; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Dec. 27, 1886. Renewed Nov. 21, 1886. In an electro-magnet, a centrally pivoted polarized armature in combination with a hook or detent, operating a signal device and placed near the centrally pivoted armature, whereby said hook is struck alternately as the armature vibrates.

411,137. Metallic Circuit; Henry F. Campbell, of Malden, Assignor to Albert C. Pond, of Boston, Mass. Application filed Nov. 24, 1888. The combination, with a metallic circuit composed of two branches or wires, one branch being an insulated conductor of high conductivity and the other branch an uninsulated wire of lower conductivity, of a bare wire wound or bound about the said branches throughout the length of the circuit, to separate and yet bind the said branches.

411,138. Electric Clock System; Charles H. Carter, of Brooklyn, N. Y. Application filed December 27, 1888. The combination of a main circuit, a master clock having circuit closing devices located in the main circuit, a number of secondary clocks provided with clock trains and having electro-magnets disposed in said main circuit, oscillating armature levers actuated by said electro magnets and provided with pallets for engaging said clock trains an auxiliary circuit composed of fixed contact studs located adjacent to said armature levers, and wires connecting the fulcum of said levers with said fixed contract studs, and a tell-tale clock located in said auxiliary circuit and operated thereby.

411,150. Electromotor; Mary A. Kissell, of Chicago, Ill., Executrix of Abraham S. Kissell, deceased. Application filed April 1, 1889. The invention consists, chiefly, in novel means for forming and breaking the electrical circuits in which the motor is joined, so as to obtain intermittent motion therefrom. In its adaptation to the regulation of heat supplying devices it may be



411,019. MANUFACTURE OF INCANDESCENT LAMPS.

used in connection with a thermostat whereby the electrical circuits are automatically made and broken according to variations of temperature.

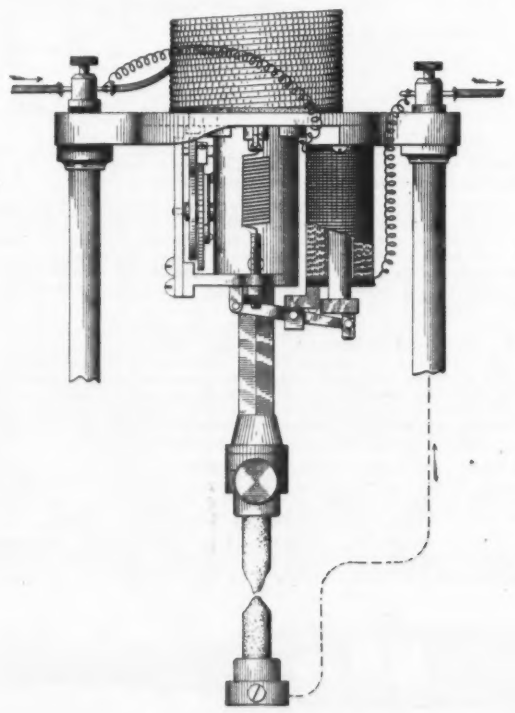
411,153. Terminal Plug Attachment for Flexible Electric Cords; Samuel C. Lafferty, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Sept. 7, 1887. The combination, with the projecting core of an electric cord and the insulation covering thereof; of the clasp consisting of two jaws pivoted to the stem of the plug and pressed firmly against said core and covering by the handle placed over the said jaws and screwed upon the thread provided on the stem.

411,168. Gong-Striking Mechanism for Synchronized Clocks; Chester Henry Pond, of Chicago, Ill., Assignor to the Self-Winding Clock Company, of New York, N. Y. Application filed May 3, 1889. The combination with a clock train, a synchronizing mechanism, and an electro-magnet and armature for operating the same, of a gong, a spring retracted hammer, and a rod independent of the clock mechanism, and extending from the hammer into the path of the said armature.

411,198. Telegraph Key; Alfred E. Johnson, of Carson City, Nev., Assignor of one-half to Moses M. Cohn, of same place. Application filed April 3, 1889. Consists of a pivotally mounted swinging key lever, a movable contact finger connected with said key lever, and a series of contacts formed to represent telegraphic characters, over which the contact finger is moved by the key lever.

411,230. Electrical High and Low Water Alarm; Daniel H. Streeper of Norristown, Penn. Application filed July 22, 1889. The invention consists in the combination, with a suitable containing vessel connected with a tank or boiler, of a pair of levers connected together by rods which carry floats, one at the lower part of the containing vessel and the other at the upper part, the floats being arranged diagonally opposite each other, so that one opposes the other.

411,238. Automatic Pole Changer; Cyrus A. Danals, of Zanesville, O. Application filed May 29, 1889. The combination with an electric circuit that is designed to have its current flow



411,287. ELECTRIC ARC LAMP.

through it in one direction at all times, of an automatic electric current pole changing device connected in the circuit between the dynamo electric machine or battery and electric appliances in the circuit.

411,287. Electric Arc Lamp; Frank E. Kinsman, of New York, N. Y. Application filed July 20, 1889. The combination, of a main circuit coil, a depending movable core therefor, a carbon holder passing axially through such core, a carbon-lifting and feed-controlling mechanism sustained by the core and engaging with the carbon carrier, a derived circuit magnet-coil, a depending core therefor, and a pivoted link connecting the same with the main circuit core, so as to depress the same for the purpose of releasing the feed mechanism when the derived circuit magnet core is raised by its coil.

411,301. System of Electric Generation and Distribution for Railway Cars; Elias E. Ries, of Baltimore, Md. Application filed April 11, 1888. The combination with a dynamo-electric generator having its armature mounted upon the axle of a traveling vehicle of a speed governor mounted upon and controlled by the axle, and the field magnet circuit of said dynamo controlled by the speed governor.

(1) 411,313. (2) 411,314. Overhead Frogs for Electric Railways; Merle J. Wightman, of Lynn, Mass. Applications filed June 22, 1889. The invention consists, essentially, in the provision of an automatically operated bridging piece of conducting material electrically connected with one of said lines and adapted to bridge the gap in the latter left for the passage of the contact device or trolley of the crossing line. Such bridge piece of conducting material maintains the electrical connection for the trolley or contact device moving upon it, and as the car or vehicle passes the crossing is actuated by means of the trolley or contact, or the trolley arm or some other part moving with the vehicle, so as to be swung or moved into position to temporarily bridge the gap.

411,370. Connector for Secondary Batteries; Sidney H. Barrett, of Springfield, Mass., Assignor to the Railway Electric Car Lighting and Signal Company, of New York. Application filed May 21, 1889. A flexible and protected connector for secondary batteries, consisting of the combination of rigid integral projections from the electrodes to points outside of and below the cell tops, mercury cups rigidly attached to the respective projections, U-formed coupling wire, and protecting and flexible sleeves.

411,380. Cut-Out; Freiderich Gustav Adolf Heller, of Berlin, Germany, Assignor to Siemens & Halske of same place. Application filed Feb. 8, 1889. Patented in Germany, Feb. 28, 1888; in France, March 9, 1888; in Belgium, March 9, 1888; in Sweden, March 9, 1888; in Italy, March 9, 1888; in Austria-Hungary, March 9, 1888, and in Norway, March 20, 1888. An automatic electric short circuiting shunt, consisting of opposed springs connected to the line wire upon the opposite sides of a lamp and depending from the bottom of it, and the non-metallic body, interposed between the lower ends of said springs, and composed of wax and pulverized graphite.

411,400. Galvanic Battery; William C. Thompson, of Minneapolis, Minn. Application filed April 15, 1889 In a carbon cell, the combination with a removable cover of a body of a carbon, crescent shaped in cross section and provided with a pole piece or projection extending through a perforation in cover, a metallic contact clamp attached to said pole piece, and an elastic packing between said contact clamp and cover.

411,407. Municipal Signal Apparatus; John C. Wilson, of Boston, Mass., Assignor to the Municipal Signal Company, of Portsmouth, Mass. Application filed July 13, 1886. In an electric circuit, a signal transmitting apparatus constructed and arranged to produce a series of changes in the circuit of long and short duration, and two relays connected in said circuit, the armature of one of which is acted upon by a retarding force, thereby rendering it responsive only to the changes of long duration, and the armature of the other of which is unrestrained, and thereby responsive to all changes in the circuit.

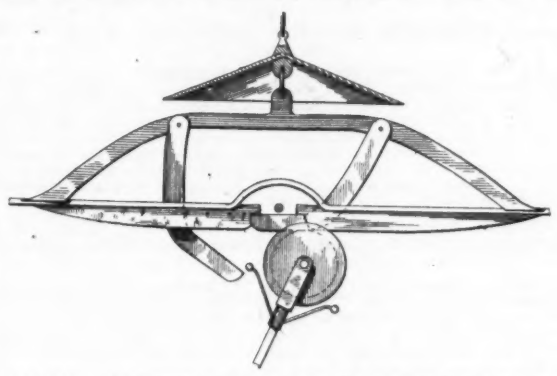
U. S. PATENTS EXPIRED SEPT. 10, 1889.

131,171. Improvement in Rheostats for Telegraphic Purposes; George Little, of Rutherford Park, N. J. A series of helices connected to insulated plates or rings, in combination with a sliding adjuster.

131,306. Impovement in Vertical Telegraph-Keys; Arthur B. Shearer, of Davisville, Cal. The especial novelty connected with the invention is its vertical arrangement by which the action and reaction of the key are freely produced without danger of an imperfect response to the manipulation of the operator.

PATENTS EXPIRED SEPTEMBER 17, 1889.

131,334. Improvement in Rheotomes or Circuit Directors; Thomas A. Edison, of Newark, N. J. This invention



411,313. OVERHEAD FROG FOR ELECTRIC RAILWAYS.

is for selecting from a number of telegraphic circuits the particular one to which a message is to be communicated.

131,335. Improvement in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. Two type wheels separately revolved by a step-by-step motion, in combination with a separate lever or levers operated by the mechanism that is moving one type wheel to set the other type wheel.

131,336. Improvement in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. Two type wheels actuated by separate step-by-step movements, in combination with a spring arm or arms extending from one lever to the other, and a yielding unison stop for each type wheel.

131,337. Improvement in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. Two type-wheels with the characters of one in line with the spaces between the characters on the other, and a step-by-step movement that is operative when the electric circuit is both closed and opened, in combination with notched wheels and mechanism for selecting the type wheel to be printed from.

131,338. Improvement in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. Two separate printing levers and their respective magnets in the same or branch circuits, in combination with two type wheels positioned, and mechanism for preventing an impression from one of the type wheels while the other is being printed from.

131,339. Improvements in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. The circuit closing arm and connection to the respective magnets in combination with printing lever type wheels and actuating mechanism.

131,340. Improvement in Printing Telegraphs; Thomas A. Edison, of Newark, N. J. A pulsator, acting to make and break the circuit to the printing magnet in combination with an arm electro-magnet and connections for arresting the pulsator simultaneously with the stopping of the type wheel.

131,341. Improvement in Printing Telegraph Instrument; Thomas A. Edison, of Newark, N. J. A printing lever and weight in combination with the type wheel and an electro-magnet.

131,342. Improvement in Printing Telegraph Instruments; Thomas A. Edison, of Newark, N. J. An electro magnet in the same circuit as the printing magnet, and operating to give end motion to two type wheels when the circuit is closed in combination with a magnet in a separate circuit to give the impression.

131,343. Improvement in Transmitters and Circuits for Printing Telegraphs; Thomas A. Edison, of Newark, N. J. A pulsator driven by friction, in combination with ranges of finger keys and the arms.

131,344. Improvement in Unison Stops for Printing Telegraphs; Thomas A. Edison, of Newark, N. J. Adjusting the type wheel to the unison point by the movement of the printing lever, while the type wheel pallets are in the opposite position to that which they occupy when the type wheel is being printed from.

131,377. Improvement in Electro-Magnetic Motors; Adolph Schreiber, of Brooklyn, E. D., N. Y. The method of regulating the speed of the machine by turning the stationary electro-magnets.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times building, N. Y.